as either to conspire with the magnetism already present, or to oppose it.

75 Re-direct-Int. In your opinion, would the instrument Exhibit Holcomb telephone operate better or otherwise, if there were attached to the wooden diaphragm a bent bow like the Exhibit Holcomb Bow No. 1, instead of the bow that is actually attached in Exhibit Holcomb Telephone?

A. It would no doubt operate better.

76 Re-direct-Int. Why?

A. For two reasons, chiefly: First, from the greater mass of inductive material in said bent bow, the variations in the magnetic moment of the magnet caused by its vibration, when used as a transmitter, will cause greater variations in the electric condition of the line wire which joins it to the receiver. Second, its greater rigidity will cause the diaphragm of the receiving instrument, which I assume to be like the one shown in the exhibit, to more faithfully copy the vibrations of the transmitter.

C. F. BRACKETT.

Subscribed and sworn to this 6th day of June, 1884, before me,

J. A. WELCH,
Special Examiner.

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29 WALL STREET, NEW YORK,
June 6, 1884, 10.30 A. M.

DIRECT EXAMINATION OF WILLIAM F. CHANNING RESUMED BY MR. PECKHAM:

29 Int. Have you examined and do you understand the construction and mode of operation of the instrument known as Exhibit Holcomb Telephone now shown you, assuming the same to be one of a pair of similar instruments connected by a line wire and used respectively for the transmission and reception of audible sounds by electricity?

A. I have examined and understand the construction and mode of operation of Exhibit Holcomb Telephone now shown me.

30 Int. Please contrast Exhibit Holcomb Telephone with the instrument described in the patent to Mr. Bell, No. 174,465, particularly in the fifth claim of said patent, and as shown in Fig. 7 of the

drawing, and state whether, in your opinion, the devices and mode of operation in the respective instruments are the same or otherwise, and in what respect they are alike or different?

A. The Exhibit Holcomb Telephone consists of a compound permanent magnet with coils upon the ends of the magnet nearest to a steel or iron plate placed opposite to the poles. This steel, or iron plate or armature is attached to the centre of a wooden diaphragm supported in a sounding box partly of wood and partly of tin, terminating in a speaking tube.

The instrument shown in figure 7 in the patent to A. Graham Bell, No. 174,465, consists of an electro-magnet with an iron armature loosely attached by one extremity to one leg of the electro-magnet; the other extremity of the armature is attached to the centre of a membrane stretched over a supporting tube. In figure 7 two of these instruments are represented connected by a line wire, but the supporting tubes differ, the membrane being stretched in one case over the smaller end of a cone, and in the other case over the larger end of a cone. The electro-magnets are connected with a battery, and with the earth for a return current. With the Exhibit Holcomb Telephone connected as described, and with provision for the return current through the earth, the general action of these instruments would be the same for the transmission of sounds of the same or different pitch. The instrument, figure 7, is not adapted to transmit sounds of quality. The Exhibit Holcomb Telephone is adapted to transmit articulate speech.

31 Int (a). Calling your attention to the classification of electric currents made by Mr. Bell in the specification for his patent No. 174,-465, I ask how you would describe the electric current used in the operation of the instrument Exhibit Holcomb Telephone; whether as undulatory or intermittent?

A. Adhering to Mr. Bell's phraseology, I cannot better describe it than in the words of the fifth claim of the said patent; that is to say, that the Exhibit Holcomb Telephone acts "by causing electrical undulations, similar in form to the vibrations of the air" accompanying the sounds delivered to the transmitting instrument.

31 Int. Please contrast the Exhibit Holcomb Telephone with the instrument described in the patent to Mr. Bell, No. 186,787, particularly with reference to the fifth, sixth, seventh and eighth claims therein, and state whether, in your opinion, the said instruments are the same or not in substance?

A. The instruments described in patent No. 186,787 differ in cer-

tain details from the Exhibit Holcomb Telephone. Part of those instruments employ electro-magnets; one of them a compound permanent electro-magnet. Part of them employ U magnets, part of them straight magnets. The U magnets differ slightly in form from the Exhibit Holcomb Telephone. The diaphragms represented are of iron or other inductive material. Excepting variations of this description, the instruments are identical in construction and use.

I will remark that the armature plate of the Exhibit Holcomb Telephone is U shaped, but that I do not consider it as materially or essentially changing the action of the diaphragm.

Referring to the sixth claim of the said patent, both the Bell and the Holcomb apparatus have sounding boxes.

Referring to the seventh claim, the conical part of the sounding box of Exhibit Holcomb Telephone is drawn into a speaking tube, essentially as shown in said patent. Exhibit Holcomb Telephone has in combination a permanent magnet with a plate of iron or steel, with coils upon the ends of said magnet nearest the plate, which is substantially the eighth claim of said patent.

32 Int. In your opinion, do the differences referred to amount to substantial differences, or are they mechanical equivalents?

A. The Holcomb Exhibit Telephone I consider to be identical with the magento form which dispenses with use of the battery in said patent, and it is the mechanical equivalent of all other forms represented, considering the permanent magnet and the electro magnet as equivalents of each other.

33 Int. I call your attention to Exhibit Specification for Letters Patent No. 32,478, dated June 4, 1861, and ask you if you have read and understand the thing?

A. I have read, and believe that I understand the same.

34 Int. Please contrast the magnet shown in that specification and accompanying drawing with the magnet described in claims 5 and 8 of the Bell Patent 186,787, and state whether in your opinion the same are substantially alike or unlike, when used in an electric speaking telephone?

A. The electro magnet figured and described in the Holcomb Patent No. 32,478, is a permanent magnet with coils upon the ends or poles, which in a speaking telephone would be opposed to a diaphragm or plate. It is identical in structure and action with the magnets described in the fifth and eighth claims of the Bell Patent, No. 186,787.

Adjourned till June 7th, 1884, at 10:30 A. M.

J. A. W.,
Sp. Exam'r.

29 WALL STREET, NEW YORK,
June 7, 1884, 10:30 A. M.

Present—MR. DICKERSON for Complainants; MR. PECKHAM, for Defendants.

EXAMINATION OF PROF. WILLIAM F. CHANNING RESUMED:

The witness requests to make the following corrections of the minutes of his previous examination, namely:

1. In my answer to the fourth interrogatory, immediately after having been speaking of Patent 186,787, I used the following language: "I find no indication whatever in this patent," &c., whereas I did not in this last expression refer to Patent No. 186,787, but to another patent, namely, No. 174,465, of which I had been before speaking.

2. In the same answer, instead of the language "as the electric transmission of speech is claimed by Mr. Bell," &c., I intended to say, "as the electric transmission of speech is claimed in behalf of Mr. Bell," &c.

3. My answer to interrogatory No. 10 was given under a misapprehension of the limitations of the question. The correct answer is as follows: With the distinctions precisely as stated in the patent, the undulatory form of current would transmit a larger number of signals simultaneously over a single wire than the pulsatory form.

4. In the last sentence but two of my answer to Interrogatory No. 21, the patent to which I was then referring, was Patent 186,787, and not Patent No. 174,465.

5. In the answer to Interrogatory No. 24, the concluding phrase of a sentence in these words, "the algebraic product of such current multiplied into the time through which it acts," should have been "a resultant representing both the waves and the time through which they act."

6. In my answer to said 24th interrogatory, the sentence reported as follows, "Telephones have been constructed in which no contact whatsoever was permitted between the electrodes of the microphone transmitter, the variation of resistance being probably due entirely to the greater length of spark or are produced by the vibrations of the diaphragm," should have read, "to the greater or less length of spark," &c.

CROSS-EXAMINED BY MR. DICKERSON:

35 Cross-Int. In the elaborate argument which you have spread upon this record under the color of an answer to question four, for the apparent purpose of convincing the Court that Mr. Bell was not the first inventor of the Bell telephone, and in which you assume for your premises, not only the matter contained in Bell's Patent 174,-465, but also his subsequent patent of 1877, and portions of letters which you say were written at some time or other on this subject, I observe that you lay great stress on certain statements contained in Mr. Bell's Patent No. 186,787, after which you conclude very strongly that figure 7 of his original patent isn't a telephone, but a multiple telegraph.

Now, as this is simply an argument more or less logical, having its force in the correctness of its logic, I propose to examine the processes, and I ask you first, do you consider it a logical conclusion, from the fact that in his seceond patent Mr. Bell shows a number of telephones in the same series, and points out how they can be used instead of a multiple telegraph, that therefore figure 7, in which a receiver is shown adapted to be inserted into the ear of the listener, and a transmitter is shown adapted to be spoken to by a speaker, is not a true telephone, but is in fact a multiple telegraph?

A. In the preface to this queston, I do not understand the allusion made to letters which I am represented as saying were written at some time or other, and confine my answer to the direct question. I do not consider it a logical conclusion from the action of the instruments shown in figure 6, that the instruments shown in figure 7 should necessarily act in the same way; but from the language in the patent and the reference in the subsequent patent No. 186,787, to the same figure 7, I think the conclusion is inevitable that the instrument figure 7, is described and represented as a multiple telegraph.

36 Cross-Int. Are you, or do you claim to be, an expert in logic, metaphysics and in the construction of written instruments, as well as in electricity, so that the Court should accept your logical and metaphysical views with any peculiar deference?

Objected to as immaterial and incompetent.

A. I do not. I am only answering your question as to a logical inference or conclusion to be drawn.

37 Cross-Int. Don't you agree with Paley, that the finder of a

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watch constructed upon a certain principle to mark time should logically infer that there was an author or designer of that watch, and that his purpose had been to develop the method which the instrument showed, or do you think that there ought to be no design inferred?

Objected to as irrelevant

A. I agree generally with Paley, but there could be a great many questions arising as to the character of the watch and as to who the creator and designer of it was.

38 Cross-Int. If, in place of a watch, the thing found should be figure 7 of Bell's patent, and this should be written upon it: "When a sound is uttered in the cone, the membrane *a* is set in vibration, the armature *c* is forced to partake of the motion, and thus electrical undulations are created upon the circuit A, *b*, *e*, *f*, *g*. These undulations are similar in form to the air vibrations caused by the sound; that is, they are represented graphically by similar curves. The undulatory current passing through the electro-magnet *f* influences its armature *h* to copy the motion of the armature *c*. A similar sound to that uttered into A is then heard to proceed from L. And suppose it was further written that this "apparatus is for transmitting vocal or other sounds telegraphically, * * * by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds." And suppose the finder to be a competent electrician, though not an expert in logic or in the construction of language, and should therefore look to a dictionary for some assistance and should find the word "utter" to be thus defined, "to speak, to pronounce, to express, or to utter words, to utter sounds."

Now don't you think that even a very moderate degree of logical faculties would lead a man to the conclusion that whoever made that instrument believed that the open cone was to be spoken to, and that the listener would hear a "similar sound to that uttered" into the cone, whatever it might be? Now, I ask you to answer that question without dragging into it any more of your arguments about what you know or don't know about what anybody else has said or done. The question, among other objects, is for the purpose of affording the Court an opportunity to estimate the correctness of your logical processes, which you have been using for the purpose of inducing the Court to believe that Bell was not the inventor of the speaking telephone.

A. If figure 7 with the inscription mentioned in the question had been picked up on the 7th of March, 1876, by a person conversant with previous inventions of telegraphy or of multiple telegraphy, he would have derived the impression that the instrument was probably intended to transmit and reproduce certain sounds. He would certainly not have inferred that the said inscription was intended to announce or contain the announcement in any definite patentable form of a discovery so great as that of the electric transmission of articulate speech. I attach no importance to the use of the word "utter." According to my recollection, Varley or Wheatstone even use the work "speak" as a general description or designation of the sounds uttered by undulatory currents used for telegraphic purposes at that date. I recognize the supposed inscription as extracts from Bell's patent No. 174,465. Preceding these extracts I find, in reference to sounds produced by figure five, this statement: "The duration of the sound may be used to indicate the dot or dash of the Morse alphabet, and thus a telegraphic dispatch may be indicated by alternately interrupting and renewing the sound;" and connecting this statement of the functions of figure 6 with those of figure 7, including the inscription contained in question, I find no reference whatsoever, to any difference of purpose of the two, but simply a difference in the agencies by which figure 5 and the corresponding instruments in figure 6 may be set in action. If the finder of figure 7 should be in possession of the patent No. 174,465, he would naturally construe figure 7 in accordance with the language just quoted.

In speaking just now of a statement preceding certain extracts and quoted by me, I said "in reference to sounds produced by figure five." I meant to say figure six.

As I have already stated in my direct testimony, the expression "vocal sounds" had been previously used in multiple telegraphy without any reference to articulate sounds.

39 Cross-Int. But, it isn't true, is it, that the quotation which you made from the patent referred to figure 5 at all, but only to figure 6; so that the premise of this last conclusion turns out to be unsound?

Objected to, on the ground that the answer being corrected by referring to figure 6, and not to figure 5, there is no statement that the quotation refers to figure 5.

A. I have already corrected my mistake of reference to figure 5,

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instead of figure 6. The separate instruments in figure 5 and figure 6, are identical, and I see nothing to correct in the bearing or effect of my previous answer.

40 Cross-Int. Now, doctor, it seems to me that you have made a departure in logic, when you began to talk about something else, instead of answering my question, and I therefore recall it. The question is, whether the electrician finding the figure 7, with its inscriptions, ought not to infer logically, as you understand that science, that whoever made that instrument and put that inscription upon it, believed and intended that the open-ended cone was to be spoken to by one person, and that the tapering ended cone was to be applied to the ear of another person, and that the listener would hear a similar sound to that uttered by the speaker, in whatever mode of the human voice the sound was uttered. And if you deny this, I ask you to tell the Court exactly what you think would be the proper logical inference to be drawn under the circumstances?

A. Confining myself to the question, I think that the logical inference that the finder would draw, would depend very much upon the fertility of his imagination, and upon his knowledge of the previous state of the science or art. I think that the finder would infer that the open end of the cone A, was to have some sort of a sound uttered into it, and that it was intended that the same sound should be heard to proceed from the "tapering end" of the cone L.

41 Cross-Int. And suppose that electrician to have been yourself, in 1876, knowing as you did, of the antecedent publications in this art, such as the Reis publications, and others, wouldn't you conclude that the quoted description, supposed to be attached to the instrument, namely, "an apparatus for transmitting vocal or other sounds telegraphically by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds," was a most complete and sufficient description of an operation which, if practicable, would necessarily reproduce speech or any other kind of sound made in the transmitter?

A. In 1876, I did not know the antecedent publications contained, I believe, exclusively in the German magazines, encyclopedias, &c., which describe the electric transmission of speech by Reis or other persons. I only knew of Reis' telephone, as described in the English or American publications, as a musical telephone. If I had picked up figure 7, with the supposed inscription, I am con-

fident that I should not have imagined that it referred to, or was in any way connected with, the electric transmission of speech.

42 Cross-Int. But suppose a companion having a different imagination from yours, and understanding the supposed inscription to justify him in uttering into the cone A the words "good-by, doctor," and you should hear them issue from the cone L. Do you know of any better set of words for describing the instrument and its operation than those used by Mr. Bell, viz.: "The method of "and apparatus for transmitting vocal and other sounds telegraph-"ically by causing electrical undulations similar in form to the "vibrations of the air accompanying the said vocal or other "sounds?"

Objected to until some means are found by which to tell what a man with one mental organization would do if he had another mental organization.

A. There are so many uncertain elements in that question that I do not know that I can answer it.

43 Cross-Int. Suppose it to be true that figure 7, put into suitable material, is a talking telephone, do you know of any better set of words for expressing that fact in accurate and scientific language than those quoted in the last question?

A. Supposing figure 7 to be a talking telephone, the words quoted might apply to it very well, but by themselves they are quite insufficient as a description.

44 Cross-Int. Yesterday, when you swore that Exhibit Holcomb Telephone was a talking telephone, and when called upon to describe its operation, you said, "I cannot better describe it than in the words of the fifth claim of the said patent—that is to say, that the Exhibit Holcomb Telephone acts by causing electrical undulations similar in form to the vibrations of the air accompanying the sounds delivered to the transmitting instrument." Now, do you think that Professor Bell made any very great mistake when he didn't think of any better words for describing figure 7 as a talking telephone, since you, eight years afterwards, and employed to defeat his patent, cannot think of any better words for describing the operation of that which you call a talking telephone?

Objected to on the ground that it assumes that in the question to which the answer was made yesterday, being In-

terrogatory No. 31, the witness was called upon to describe the operation of the Exhibit Holcomb Telephone, whereas in fact he was asked how he would describe the electric current used in the operation of the Exhibit Holcomb Telephone, whether undulatory or intermittent.

A. Admitting the assumption that Professor Bell had it in his mind to describe figure 7 as a talking telephone, I think those words descriptive, adhering to his phraseology, of the kind of current acting in those instruments and in the Exhibit Holcomb Telephone referred to in my previous answer; but I do not consider it, in the language of the question, as a sufficient description of figure 7 as a talking telephone.

46 Cross-Int. Didn't you mean to swear that the Exhibit Holcomb Telephone transmits speech by causing electrical undulations similar in form to the vibrations of the air accompanying the sounds delivered to the transmitting instrument, and that the form of words quoted from Bell's patent was the best form of words thought of by you for expressing the operation by which speech can be transmitted?

A. Undoubtedly, I meant that the Exhibit Holcomb Telephone transmits speech or any other sounds in the manner stated by me and quoted in the question, and that that quotation from the fifth claim expressed in as good words as occurred to me in response to the question which I was answering, the character of the current concerned in the action of the Exhibit Holcomb Telephone.

47 Cross-Int. Isn't it your true belief, notwithstanding your argument to the contrary, that Bell's discovery as exhibited in that patent of 1877, is entirely unique and complete, and probably the greatest discovery in electrical science applied to the arts with which you are acquainted?

A. It is not.

48 Cross-Int. I now show you a letter and ask you if it is in your handwriting and your signature?

A. That appears to be my handwriting and my signature, as far as I have had an opportunity to look at it.

49 Cross-Int. That letter is dated January the 16th, 1878, and contains this statement: "I repeat what I have often said, that Professor Bell's discovery was unique and complete, the greatest perhaps of modern science applied to the arts, and there is no place for rivalry, if there was such a thought or desire on the part of those

who have helped much or little in its practical embodiment." Now, did any one employ you or pay you anything for writing that letter, or was it voluntary and spontaneous on your part and truthful so far as you then knew or believed?

Objected to on the ground that it purports to state the contents of a letter or part of its contents without the letter having been put in evidence, and that proof of the contents of the letter or assumption of its contents are not competent until the letter or the part thereof referred to is put in evidence.

A. I need not say that I was not employed or paid to write the letter in question. I have no remembrance of the letter, of the extract, or of its context, but it is only one of many similar enthusiastic expressions or tributes to Mr. Bell made by me at that time while supposing that Mr. Bell was really the discoverer of the electric transmission of speech. Similar expressions are probably contained in hasty laboratory letters of mine to Mr. Bell himself.

In a previous answer I have already alluded to my ignorance at the time of the continental publications with regard to Reis' previous discovery of the same thing.

50 Cross-Int. In the same letter you make this statement, "Professor Pierce, Professor Blake and myself were equally fascinated by Professor Bell's wonderful discovery." Wasn't that a true statement of your state of mind at that time?

Objected to on the same ground, and additionally that there is no evidence that the letter contains any such statement.

A. Undoubtedly.

51 Cross-Int. Didn't you and the Professors there named understand what Bell's telephone was when you wrote that letter?

A. Well, sir, we had made a very large number of experimental telephones and were presumably thoroughly acquainted with the subject, practically considered.

52 Cross-Int. Didn't you derive your information of the principle and mode of operation of this wonderful discovery from Professor Bell himself?

A. I did.

53 Cross-Int. So far as you knew at that time, did there exist in the world any published statement to the effect that the human voice

could be in substance and effect transmitted telegraphically by causing electrical undulations similar in form to the vibrations of the air accompanying the sounds of the voice made in a transmitter, or do you now know, being employed to defeat this patent, and presumably having examined this patent for that purpose, of any publication before 1876, in which it is stated that the human voice or any other kind of sound can be transmitted over a wire by means of an undulatory current whose undulations are similar in form to the air vibrations caused by the sound whereby a similar sound to that uttered in the transmitter will be heard to proceed from the receiver. If so, refer the Court to any publication in which any instrument is described as acting on that principle for the transmission of sound?

Counsel for the defendants asks counsel for the complainants, as he has left the subject of the letter referred to in the preceding interrogatories, to hand the same to the Examiner, that it may be marked and inspected by the counsel and witnesses.

Counsel for the complainants does not produce the letter.

A. So far as I know there did not exist at the time any publication precisely of the character described in the first clause of the question, confining myself exclusively to the question without regard to any personal imputation contained in it. I know of no publication before 1876, containing the precise matter stated in the latter part of the question.

54 Cross-Int. And don't you also know or believe that the electrical transmission of speech depends upon the precise mode of operation stated in that question?

A. I do not. It is the merest assumption that no other method exists for the transmission of articulate sounds than what is called the undulatory current. The vibrations of sound which enter into articulation are not undulatory. In their ultimate analysis they are to and fro vibrations in a straight line.

They do not resemble the waves of the ocean nor the undulatory curves which for convenience are made to represent the form of simple or compound sounds in their relations to time. We have no evidence whatsoever that any articulate sound cannot be reproduced in the telephone by as many separate electrical impulses as there are separate sound vibrations, the electrical impulses corresponding pre-

cisely in number, intensity and combination with those of sound. (Answer suspended).

Adjourned till June 17, 1884, at 10:30.

J. A. WELCH,
Special Examiner.

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29 WALL ST., NEW YORK, }
June 17, 1884, 10:30 A. M. }

Met pursuant to adjournment.

Present—MR. DICKERSON for complainants. MR. PECKHAM and MR. KNOX for defendants.

CROSS-EXAMINATION OF WILLIAM F. CHANNING RESUMED BY MR. DICKERSON:

Answer to Cross-Int. 54 continued.

In saying above that the vibrations of sound that enter into articulation are not undulatory, I should have added, in the form usually represented by graphic curves. The motion of the air particles is a to and fro vibration in a straight line, both when under a simple impulse of sound or under several impulses. The effect of several vibrations upon an air particle represented by sinusoidal curves is shown in Mayer's diagram on 53d page of evidence for complainants. The resultant form of vibration is given in the curve *c d*. An analysis of this curve shows that the ultimate effect of these several vibrations is not only an arrest but reversal of the motion of the air particle several times in the course of a single vibration.

It is these variations in the velocity or direction of motion of the air particle, which, according to the theory of Helmholtz, establishes the character or quality of the sound. The diagrams of Prof. Blake on pages 54 and 55 of evidence for complainants, which are the actual photographic record of the vibration of a telephone diaphragm under the influence of sound, show these same arrests and reversals of motion in the diaphragm itself.

In an article by Prof. E. W. Blake, published in the "American Journal of Otology," Vol. 1, April, 1879, describing "A Machine for Drawing Compound Harmonic Curves," is given a plate showing a variety of curves actually obtained by the instrument.

As stated by him, the instrument is capable of describing upon paper the resultant curve belonging to the chosen relations of

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"period," "amplitude" and "phase" of several simple harmonic curves.

He also states that the relations of these three terms may be varied to any extent within practical limits, and with great ease. I present, as part of my answer, the plate displaying the curves referred to, and the accompanying page of explanations. There is still another record of the vibrations of the air, which is the well-known record of the phonograph, impressed upon tin foil by a style moved by the vibrating diaphragm.

The characteristic to which I wish to draw attention in all these records, is that the effect of compound sounds, such as enter into articulation, is to produce a very few abrupt and marked changes in the motion of the telephone diaphragm, and of its equivalent in the phonograph. I wish also to draw attention to the fact that these changes in the motion of the diaphragm, which are the principal characteristics of its articulating action, are often or mainly arrests or reversals of its motion. An arrest of the motion of the diaphragm means an arrest of the current. A reversal of the motion of the diaphragm means an interruption and reversal of the electric current.

Interpreting thus these graphic records, I have no hesitation in saying that the elements of articulation which are actually influential on the plate, and which ever actually reach the distant receiving end of the line, may consist entirely of makes and breaks of different order, duration and force.

It is not necessary that a current of this character, for purposes of ordinary articulation, should present but a few of the principal varations in sound, which produce articulation in its utmost perfection. This is shown by the microscope in the tin foil record of the phonograph, which exhibits but a few principal indentations, and yet is able to reproduce articulate speech. The photopraghic record of Prof. Blake, already referred to, of which a reduced copy is given in the evidence for the complainants, shows, in the original photographs of twice the size of the diagrams on pages 54 and 55 of that evidence, but slight variations in form, in addition to those in the reproduced diagrams. I speak from a careful study of the original photographs, which have never been touched by hand.

In the case of magneto transmission, all the variations of form in the curves representing articulate sound may be reproduced through the induced undulatory current in response to the vibrations of the diaphragm.

In the case of microphone transmission, as I have already stated,

the current may be varied by the various methods in which resistance is varied between electrodes in movable contact with each other; but, even in this case, it is a question whether the principal elements of articulation are not due to actual momentary interruptions of the current occurring in the course of a single vibration of the diaphragm.

In the case of the loose-contact transmitters, of the character of the Exhibit Defendant's Transmitter, where the points of contact or interruptions of contact are innumerable, the probability is that all of the special elements of articulation above referred to, occurring within the limit of each vibration of the diaphragm, are due essentially to makes and breaks of the current. This is evidenced by the electric spark seen between the electrodes or break-pieces of such transmitters during articulation. In the course of a conversation carried on between two parties through instruments of the character of Exhibits Defendants' Transmitter and Defendants' Receiver, with the usual connections with the switch-board and line-wire, I removed the plugs from the switch-board, placing one of them upon my tongue and holding the other in my hand, causing the current to pass through my body. Under these circumstances, a telephone in the same circuit being at my ear so that I could carefully observe the character and perfection of the articulation, I felt a rapid succession of small shocks upon the tongue at every prominent word uttered, without any disturbance of articulation. These shocks I consider to be due to the arrest or the reversal of the current, equivalent to a make and break of the character already referred to.

I am able to adduce, what I will not call a proof, but an evidence, much more direct than this, that articulation may be produced by the method of an electric currnet alternately made and broken. An instrument has been constructed and is in existence, in which what I think must be accepted as undoubted articulation is produced by simply making and breaking the electric current. This instrument consists of a toothed-wheel rheotome of about thirty-seven inches diameter. The wheel is of iron with a brass tire. This tire has a large number of minute serrations, on which when in rotation, a spring bears. This spring is connected with a single Leclanche cell, the other pole of which passes to a large electro-magnetic telephone receiver, the return wire of which is connected with the axis of the rheotome wheel. The receiver resembles a tambourine of about ten inches diameter. The serrations on the tire of the wheel I understand were planned, as regards their distance and grouping, upon a

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careful study of a phonograph record. When this wheel was turned by hand I heard the word "hello" proceed from the tambourine receiver. The sound of the aspirate *h* and of the *e* and the *o* were very good. The articulation, as good as I have often heard it in telephones, was due simply to makes and breaks of the electric current, so arranged as to effect changes in the pitch and the intensity of the sound produced in the receiver. I see no reason why the same method should not be applied to reproduce essentially the sounds whose forms are represented by the graphic curves of Prof. Blake, which I have just put in evidence.

While I wish to make the statement with great caution that telephonic articulation has actually been artificially obtained by the simplest make and break apparatus, I yet say that the presumption contained in the question, that the undulatory current is the only method by which speech can be electrically transmitted, is overthrown.

Referring to page 47 of evidence for complainants, in the deposition of Charles R. Cross, I find these words: "No form of trans-"mitter which operates by making and breaking an electrical "circuit can possibly transmit articulate speech or any other sound "in its different characteristics of pitch, intensity and quality, for "the reason that the constant control of which I have spoken is "not exercised in such an instrument." This assumption of an impossibility is contradicted by my preceding analysis of graphic records and by the experiments and observations which I have just stated.

It was a celebrated saying of Arago, which has passed into a scientific axiom, that he is a rash man who outside of pure mathematics pronounces the word "impossible."

Recurring to the rheotome transmitter which I have described, I omitted to state that when the wheel was turned slow the pitch of the word fell, and as it was turned faster the pitch rose. In describing the operation of the Reis instruments I referred to alternate makes and breaks of the current at every half vibration as fatal to articulation. This adjustment could only have been effective for the transmission of music and of melody rather than harmony. I do not know that the method of the electrical transmission of speech referred to in the question is the only possible way, as I do not believe that the electric undulations are ever similar in form in any accurate sense to the vibrations of the air accompanying the sounds of the voice made in a transmitter. The method of electrical trans-

mission is complex and artificial, and for reasons already stated differs widely from the air vibrations which originate it.

The defendants offer in evidence the two pages referred to in the preceding answer in the "American Journal of Otology," Vol. 1, April, 1879, and the same are marked "J, A. W., Special Examiner, June 17th, 1884."

55 Cross-Int. In whose possession, when and where did you first hear the apparatus which you have described as an articulating machine perform the feat of speaking by turning a circuit breaker, from which feat you deduce the conclusion that the theory propounded in Bell's patent, for the transmission of speech, is overthrown?

Objection to all the question beginning with the words "from which you deduce."

A. I have not deduced the conclusion that Bell's theory is overthrown, but simply that the assumption that that is the only method by which speech can be electrically transmitted is set aside. I first saw the rheotome transmitter at Room 22, No. 187 Broadway, this morning, in possession of James W. McDonough, by whom, I understand, it was constructed. I first heard of the instrument from Prof. C. F. Brackett several weeks ago.

56 Cross-Int. Is it true or not, to the best of your knowledge, information and belief, that speech is transmitted in the Bell magneto telephones by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds?

A. It is so far as general similarity is concerned. As I have already pointed out in detail, there is a very large divergence between the electrical undulations and the air vibrations; and these cannot well be otherwise.

57 Cross-Int. And isn't it also true, that in so far as that divergency exists, to that extent the apparatus fails to transmit a similar sound to that which is uttered into the transmitter?

A. That depends upon the precision with which the word "similar" is used; whether it means identical, or simply general resemblance.

58 Cross-Int. Isn't it theoretically true that if the electrical undulations could be truly represented by the same curve which

would represent the air vibrations, that then the sound heard at the receiver would be exactly like that spoken to the transmitter, in quality and pitch?

A. If the curves representing the electrical undulations were precisely similar to those of the air vibrations originating them—which they never can be—the undulations and the air vibrations would be precisely similar in form.

59 Cross-Int. Question repeated?

Repetition objected to, because the question is answered.

A. If the electrical undulations could be exactly represented by the same curves which represent the air vibrations, then it would be theoretically true that the sound spoken to the transmitter would be exactly like the sound heard at the receiver, in quality and pitch, so far as the sound heard at the receiver is a simple product of the electrical current.

60 Cross-Int. What other cause than the magnetism generated by the electrical current operates in the magneto-telephone, to produce the vibrations of the diaphragm in the receiver, which produce the sound heard there, which you had in your mind when you qualified your last answer?

A. For one, I thought of the effect of resonance in the mouth-piece or ear-piece of the receiver, and induced currents the product of the magnetism of both transmitting and receiving magnets, reacting upon the receiving diaphragm.

61 Cross-Int. Isn't it true that the disturbing elements, whatever they are, result from the imperfection of the apparatus constructed to carry out the theory, and not to any defect in the theory itself, which aims at the transmission of speech by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds to be transmitted?

A. I should say that it rather resulted from the discordance of Prof. Bell's undulatory theory with his apparatus.

62 Cross-Int. I would rather have you answer the question which is in substance whether the defect, if there is any, is due to the theory upon which the instrument is constructed, or to the difficulty in making an apparatus which will perfectly execute that theory.

A. I think that the apparatus preceded the theory, and that the theory was not an accurate statement of the apparatus within the limits of difference which I have heretofore expressed.

63 Cross-Int. Then you think, do you, that when Mr. Bell constructed his telephone he either had no theory of its mode of operation or had some other theory than that propounded in the patent; and if you say you know anything about it, will you inform the Court what that other theory was and how you know it?

A. I refer to the theory contained in Prof. Bell's first patent, which, as I have heretofore stated, does not describe his telephone; by which I mean the speaking telephone under the name by which it is commonly called.

64 Cross-Int. You swore just now that Bell's apparatus preceded his theory, and that his theory didn't truly agree with his apparatus. You then say that you referred to the theory contained in the first patent. Now, I ask you whether you say the apparatus shown in the first patent preceded the theory contained in the first patent; and, if so, upon what theory of action for the transmission of sound Mr. Bell constructed figure 7, if it were not the theory propounded in the patent, which is thus stated: "When a sound is uttered in "the cone, the membrane *a* is set in vibration, the armature *c* is "forced to partake of the motion, and thus electrical undulations are "created upon the circuit E, *b*, *c*, *f*, *g*. These undulations are "similar in form to the air vibrations caused by the sound; that is, "they are represented graphically by similar curves. The undula- "tory current passing through the electro-magnet *f* influences its "armature *h* to copy the motion of the armature *c*. A similar sound "to that uttered into A is then heard to proceed from L?"

A. I did not swear just now that Bell's apparatus preceded his theory, but that I thought that it did. In my answer to the 62d and 63d cross-interrogatories I refer to the undulatory theory of Prof. Bell's first patent and to the apparatus described therein, according to my understanding of that apparatus, as heretofore stated. I have no knowledge whatsoever upon what theory Prof. Bell constructed the apparatus represented in figure 7.

65 Cross-Int. And isn't it certainly true that the theory of that patent, as quoted in the last question, correctly described the operation of figure 7, provided it will operate at all when a sound is uttered in the cone A? I ask you not to swear that the drawing isn't sufficient, but to assume, for the purposes of your answer, that a thing made substantially in accordance with that drawing is in existence and will transmit a sound uttered to A?

A. I should be unwilling to say that the passage quoted describes with perfect correctness the operation of figure 7, as it in-

volves the precise question of the correspondence between the undulatory currents and the air vibrations as heretofore answered.

66 Cross-Int. What did you mean then by swearing that the so-called Holcomb telephone "acts by causing electrical undulations similar in form to the vibrations of the air accompanying the sounds delivered to the transmitting instrument," if it is not true, as you now say, that in the Bell telephone the electric vibrations are not similar in form to the vibrations of the air, and that such a description is not a correct description of its operation?

A. In referring to the language of Prof. Bell's patent in my answer to the 65th interrogatory, I have applied to it the test of perfect correctness used in testing the sufficiency of description in the patent. While I have stated in great detail the difference between the electrical current transmitted and the air vibrations, I cannot admit, within the limits to which I have referred, the precise correspondence between Prof. Bell's undulatory theory and the air vibrations.

After being requested to contrast Exhibit Holcomb Telephone with figure 7 of Bell's patent, and being asked how I would describe the electric current used in the operation of the Holcomb instrument, I answered: "Adhering to Mr. Bell's phraseology, I cannot "better describe it than in the words of the fifth claim of said "patent." One reason why better words than those of the fifth claim could not be used in answer to the question was, that they involved a prominent question of difference or resemblance at issue between the two instruments which I was requested to contrast; the word "similar," in its ordinary, not very definite sense, being sufficiently accurate for the purpose of my answer.

67 Cross-Int. Since you are able to criticise this description, perhaps you will do the Court the favor to express the relation between the air waves of sound and the electric current resulting from those air waves through the intervention of the magneto telephone, which will be free from any possibility of criticism?

A. It would be difficult to do so, except by repeating descriptions and statements of resemblances and differences, and of causes of resemblance and difference, which I have already spread upon the record; I can repeat the statement, or any portion of it that may be desired.

68 Cross-Int. I will accept your pages of statement, as your idea of a correct description of the relation between the sound waves and the electric current resulting therefrom, without calling upon you to

say it all over again; but I ask you whether you really think that when Prof. Bell said a similar sound to that uttered into A is that heard from L, he meant to say that the sound should be exactly alike in loudness, quality and pitch, and that when he used the expression that "these undulations are similar in form to the air vibrations caused by the sound; that is, they are represented graphically by similar curves," he really meant to say that there was a form in an air wave and a form in an electric wave which were alike, or that he meant anything more than to say that generally similar curves could be made to represent the actual two factors in the problem, without intending to say that the two sets of waves were precisely identical?

A. I can only accept what Prof. Bell said as what he meant to say. My opinion is, that he supposed there was a much greater resemblance between the electrical undulations and air waves than actually exists.

69 Cross-Int. He said: "A similar sound to that uttered into A is then heard to proceed from L." As you understand the English language, is that a statement that the sound proceeding from L is exactly the same as that uttered into A, in loudness, pitch and quality?

A. Taken by itself, no.

70 Cross-Int. Isn't that description complied with substantially in any ordinary magneto telephone in use?

A. For certain uses, it is; but the difference between the voice heard and the voice spoken into the transmitter is very great, and is a matter of skilled as well as common observation.

71 Cross-Int. And yet isn't it true that the sound proceeding from the receiver is recognizably similar to the sound uttered into the transmitter?

A. Yes; recognizably similar, though not always recognized.

72 Cross-Int. Now, will you tell the Court what form of expression you would substitute for this form of expression, which would convey the idea better, after having had the experience of years on the question?

A. No better form of expression occurs to me at this moment as a general statement, though not precise enough to put in a patent or to stand by itself.

73 Cross-Int. Do you consider yourself an expert in patent law, and a judge of the requirements of the law in respect to specifications?

A. I do not, although I have had more or less experience in preparing specifications.

Adjourned till June 18th, 1884, at 10.30 A. M.

J. A. W.,
Special Examiner.

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29 WALL STREET, NEW YORK,
June 18, 1884, 10.30 A. M.

Met pursuant to adjournment.

Present—Same counsel as yesterday.

CROSS-EXAMINATION OF WM. F. CHANNING RESUMED BY MR. DICKERSON.

74 Cross-Int. When, in 1878, you wrote "I repeat what I have often said, that Prof. Bell's discovery was unique and complete, the greatest perhaps of modern science applied to the arts," what was the "discovery" to which you referred in such terms of admiration, unless it were the discovery of the mode of operation specified in the patent and quoted in my 64th question?

A. I think it was the discovery simply of the electric transmission of speech.

75 Cross-Int. And it wasn't the discovery of the mode of operation by which speech is transmitted, but only the fact of transmission that you were expressing your admiration for, was it?

A. Without the letter before me, I think it was only the discovery in general terms which was present to my thought.

76 Cross-Int. At that time didn't you understand perfectly Prof. Bell's theory of the action of his telephone, or were you ignorant of that, knowing only that a telephone existed, without understanding its mode of operation?

A. Supposing that by Prof. Bell's theory is meant the theory contained in his first patent, I cannot remember whether I had seen Prof. Bell's first patent on the 16th of January, 1878. I became acquainted with Prof. Bell's second patent much earlier.

77 Cross-Int. At the date of that letter didn't you perfectly well understand that the theory of Bell's telephone was that the undulations of the electric current on the wire were so similar to the air vibrations that both might be represented by substantially similar curves, and that upon the substantial similarity of the two

sets of curves depended the accuracy with which the sound uttered at the transmitter would be reproduced at the receiver?

A. In general terms I suppose that I knew at that time that that was the theory, though I do not wish to assume any greater knowledge than I really possessed.

78 Cross-Int. Assuming it then to be true, that your letter at that time was not intended to express your admiration of the "discovery" of that mode of operation, I ask you now, in the year 1884, whether you don't think that the man who discovered that mode of operation for the transmission of speech, whoever he may have been, made one of the greatest discoveries of modern science applied to the arts? And if you deny that, name what other discoveries in this century you consider superior to it?

A. The clause of my letter which has been read to me, was intended to express my admiration for the discovery of the speaking telephone. My opinion now is, in the year 1884, that Philipp Reis, the man who discovered that sounds communicated to a diaphragm with suitable electrical connections could effect such changes in an electrical current traversing a line wire that a diaphragm at the other extremity of the line responding to the vibrations of an electro-magnet should copy the motions of the transmitting diaphragm with sufficient accuracy to transmit intelligible speech, made one of the greatest discoveries of modern science applied to the arts.

79 Cross-Int. Won't you answer the question which I put? It is this, in substance: Don't you think that the discoverer of the method of, and apparatus for, transmitting vocal or other sounds telegraphically, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, being substantially the magneto-telephone, which for designation I call Bell's, whether that man was named Reis, or Holcomb, or anybody else, made one of the greatest discoveries of modern science applied to the arts?

A. I intended and supposed that my answer to cross-interrogatory 78 was precisely responsive. In general terms, yes.

80 Cross-Int. Don't you also know it to be true that neither Philipp Reis, nor any other author whose publications on that subject you have read, attributes to Philipp Reis the invention of that method of operation for transmitting vocal sounds by causing electrical undulations similar in form to the vibrations of air accompanying said vocal sounds? And if you deny that, point out to the Court

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in any of those publications made before 1876, any statement that any other mode of operation was practiced by Philipp Reis than that in which the electric circuit was broken and closed at each vibration of the diaphragm?

A. I do not know that no author attributes to Philipp Reis the undulatory method of transmitting vocal sounds. I do not know that in any publication previous to 1876 the operation of Philipp Reis in transmitting speech was or was not stated to be other than that of making and breaking the electric current.

81 Cross-Int. Do you know of any publication before 1876, which describes the method of Philipp Reis to be anything else than that of making and breaking the electric current of each vibration of the diaphragm? If you say you do, produce the publication and point out the description?

A. I do not know of any such description in terms, but Reis' own description of the operation of his telephone shows, I think conclusively, that his method of transmitting speech was identical with the method of microphone transmission, employing, for instance, the Berlinner or Blake transmitter, whether that method be undulatory or not.

82 Cross-Int. Point out to the Court specifically that statement of Reis which you in substance swear describes a microphone transmitter, as distinguished from a circuit breaker, in which the circuit is broken at each vibration of the diaphragm?

A. I do not recall any such precise statement of Reis in terms, but the instrument commonly called the bored-block transmitter, figured and described in the article of Reis contained in the Yearly Report of the Physical Society of Frankfort, years 1860–1, and the instrument known as the cubical-box transmitter, represented and described in the article from Pisco's Acoustic Apparatus, of 1865, both show microphones which will talk, as I know by direct experiment, in accordance with the object and purpose of Reis, reiterated in the first of the publications referred to. Also the transmitting instrument represented and described in the Reis-Legat article from the "Journal of the German-Austrian Telegraph Association" of 1862. This instrument, though acting by a reversed lever motion, as stated in my direct testimony, still acts as a microphone when it transmits speech, as in my own experiments with it. This form of microphone probably talks through the electric arc formed between the electrodes by the electric current produced by the five Bunsen cells represented in the figure. This method of talking through the

electric arc is not hypothetical, but is used in one or two telephones, and I have used it myself with entire success. It bridges over what is called the make and break in the metallic circuit of Reis' or other telephones.

83 Cross-Int. In the first article you cited Reis says: "At the "first condensation the hammer-like wire *d* is pushed back; at the "rarefaction it cannot follow the retreating membrane, and the cur- "rent traversing the strip is broken, until the membrane, forced by "a new condensation, again presses the strip (proceeding from *p*) "against *d*. In this way each sound wave causes a breaking and "closing of the circuit." Do you understand that this description by Reis of his mode of operation is the description of what you understand to be a microphone transmitter, or is it the description of a circuit-breaking transmitter?

A. I should say of a circuit-breaking transmitter, which by adjustment could be easily shaded off into a microphone transmitter.

It must be borne in mind, if the object is to reach the truth with regard to Reis' telephone, that he used it for two purposes, one for transmitting speech and the other for transmitting music, requiring different adjustments.

84 Cross-Int. Will you be good enough to point out to the Court, in that description, where Mr. Reis informs the world that his apparatus is to be adjusted in different ways when music and speech are to be transmitted; and how those different adjustments are to be made to accommodate it to each requirement; and where on the drawing or elsewhere in the article the adjusting apparatus is exhibited, and what it consists of?

A. I do not know that Mr. Reis specifies any different adjustment. He left that probably to the scientific men, and others whom he addressed, who were accustomed to the use of instruments. Those adjustments are to be made by the more or less delicate contact of the electrodes of the microphones. In the bored-block this may be effected by bending back the thin strip of metal or spring connected with the screw-cup N.

In the cubical-box transmitter, in the original Reis form, there is no special elastic adjustment, while the tension of the membrane continues the same, and the adaptation to music or to articulate speech is obtained by bringing the source of sound nearer to or farther from the speaking tube S of the instrument.

In the Reis-Legat transmitter delicate adjustment is provided for between the electrodes by the spring G and adjusting-screw H.

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85 Cross-Int. Didn't you know when you swore, in answer to the seventy-ninth question, that Philipp Reis had shown "that a diaphragm at the other extremity of the line responding to the vibrations of an electro-magnet, should copy the motions of the transmitting diaphragm with sufficient accuracy to transmit intelligible speech," that there was no Reis machine shown in any of the publications to which you have referred, in which there was a diaphragm at the other extremity of the line responding to the vibrations of an electro magnet?

A. I used the word diaphragm inadvertently, in so far as it means a circular elastically supported armature. The Reis electro-magnetic receiver is, so far as I know, or have ever heard, unless anticipated by Holcomb, the original type of all the electro-magnetic telephone receivers. I refer, in the order of their supposed invention, to those of Holcomb, Van der Weyde, Drawbaugh, McDonough, Elisha Gray and Bell; being the instrument which has been commonly called the Bell receiver. The Reis-Legat receiver, as a telephonic instrument, contains, I believe, the essential elements or equivalents of all of these. The circular diaphragm, being an improvement simply, but an equivalent in its mode of action to the elastically supported and expanded armature of the Reis-Legat receiver. The broad plank, which forms at the same time the lever and a part of the armature, considered as a vibrating apparatus, is the equivalent, for telephone purposes, of the diaphragm, causing the air in its neighborhood to vibrate audibly, as is done by the diaphragm. When I spoke of the diaphragm at the receiving end of the line, I intended this equivalent expanded, elastically supported receiving armature of the Reis-Legat electro-magnetic receiver. The vibrating wooden plank of the Reis-Legat receiver is vibrated by the iron of the armature, just as the wooden diaphragm of the Exhibit Defendants' Receiver is vibrated by the goose-neck extension of the magnet of the Exhibit Defendants' Receiver, or in a manner corresponding thereto. I make this reference to show that the vibrating body, or diaphragm, may be of wood.

86 Cross-Int. Then you mean to say, do you, that the Legat receiver could be substituted for the so-called Bell receiver in the telephone, and produce the same effect; the one being the equivalent of the other?

A. Not quite so conveniently, the circular diaphragm being an improvement on the plank of the Reis-Legat machine; but I have heard the Reis-Legat receiver talk admirably, and if it were put in

a box against the wall, or the sound otherwise enclosed and concentrated, it could be used practically as a substitute for the receivers having a circular diaphragm, though not probably quite so good.

87 Cross-Int. If I understand your eighty-fourth answer, you mean to say, in substance, that Reis discovered what is now known in substance as the microphone telephone, which he described as a circuit breaking apparatus, and that he probably left it to scientific men and others whom he addressed, to make the necessary adjustments and arrangements for converting it into a microphone transmitter, because such adjustments and arrangements were obvious enough to any man of science, and need not be described?

Now, I find that in the next article from which you quote, published in 1865, as proof that Reis had invented the microphone telephone, this is stated about it: "The apparatus of Reis is indeed a "telephone, but not a phonic telegraph. The only means of trans- "mitting song and speech, and this only from moderate distances, is "the old and well-known speaking tube. But the experiment of Reis "can always be classed with the most beautiful and interesting of "school experiments; and as the means for producing it are sim- "ple, the apparatus of Reis will surely soon find its way even into "moderately endowed institutions." This publication also occupies about ten pages of the book devoted largely to instructions how to use the instrument, and it shows an apparatus of Reis' construction to which is attached a telegraph apparatus, so that the operators at the two ends may communicate with one another telegraphically. Now, how do you explain it, that when Reis described a talking telephone, to be operated microphonically, yet five years afterwards such a publication as the one you have quoted to prove your theory, should have appeared in Germany as an exhibition of Reis' invention, which repeats his circuit breaking invention exactly, but does not say anything about the microphonic invention, and which informs the world that a speaking tube is the only way of transmitting speech to a distance, notwithstanding the Reis apparatus which you now swear is described as a talking apparatus. And doesn't it make you somewhat doubt the truth of your statement, that the Reis publication described a microphone telephone?

Adjourned till June 20, 1884, at 10:30 A. M.

J. A. WELCH,
Special Examiner.

29 WALL STREET, NEW YORK,
June 20th, 1884, 10.30 A. M.

Met pursuant to adjournment.

Adjourned by consent of counsel till June 24, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

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29 WALL STREET, NEW YORK,
June 24th, 1884, 11 A. M.

Met pursuant to adjournment.

Present—MR. DICKERSON, for complainants; MR. PECKHAM, for defendants.

CROSS-EXAMINATION OF MR. CHANNING, RESUMED BY MR. DICKERSON:

87 x-Int. being read to witness:

A. My reference to the article from Pisco's Acoustic Apparatus was merely a reference to the figure of the cubical box transmitter contained therein. I understand this to be the article referred to in the question. The writer of the article apparently had a very poor Reis instrument and did not know how to use it. It has no value except as an account of somebody's failure and of somebody's conclusions drawn from a failure. A negative result of this kind certainly would not influence my opinion of facts positively reported by other witnesses, and of the facts of my own observation.

88 x-Int. Will you be good enough to point out to the Court what other witnesses, before 1876, pointed out that Reis had discovered or constructed or operated a telephone in which a microphone transmitter, as distinguished from a circuit-breaking transmitter, was used?

A. I do not understand that either Pisco or any other witness referred to a microphone, which I suppose is a word of recent introduction; but the thing itself, as I have already stated, is the agent and method by which the current is varied in all delicate adjustments of the Reis transmitters.

89 x-Int. Who before 1876 pointed out how the Reis apparatus would operate, otherwise than by making and breaking the circuit at each vibration; or that by delicate adjustment it could be made to operate by varying the strength of current without breaking it?

A. I do not know that it was specifically so pointed out by any one, but it is a necessary inference from Reis' expressed purpose of transmitting the sounds of speech and of his reference to the results attained.

90 x-Int. Now explain to the Court why it is a necessary inference from Reis' expressed purpose of transmitting the sounds of speech and of his reference to the results obtained that he must have invented, constructed and operated a transmitter which varied the strength of current without breaking it?

A. I consider it a necessary inference, where articulation was attained to a greater or less extent, that the circuit or current was not broken at each vibration, in the sense which has been referred to, of an alternate make and break. I used the word "varying" the current in the sense of microphone transmission, which, as I have stated, from a very careful study, probably includes minute arrests and reversals of the current in the course of a single vibration.

91 x-Int. Then you mean to say, do you, that microphone transmission, as now understood, in fact means an interruption of the current, or as Reis puts it in his article when describing his operations: "The current traversing the strip is broken. * * * In this way each sound wave causes a breaking and closing the circuit?"

A. I do not know how the very complex subject of microphone transmission is understood in the sense of general agreement. It is a subject still under discussion; I have already stated in detail my reasons for believing that the elements of articulation in microphone transmission may be introduced by minute interruptions within the limits of a single vibration. This is not the kind of interruption of current referred to by Reis in the quotation contained in the question.

92 x-Int. Does Reis anywhere describe or suggest the kind of interruption which you think possibly may exist in what is known as microphone transmission, as forming any part of the process used by him in forming his apparatus?

A. He does not discuss it all, so far as I know.

93 x-Int. You have told the Court about an apparatus which you say is a circuit-breaker, and which is made to say "hello" by turning a crank. Do you wish the Court to infer that therefore microphone transmission is done by circuit-breaking?

A. I should prefer to say that I believe it may be done by circuit-breaking, making the distinction between the momentary break of the circuit in the course of a single vibration and the mak-

ing and breaking of the circuit in alternate vibrations. I think variations of the current by pressure and other causes producing change of resistance at the point of contact of two electrodes may produce much, perhaps all, of the effects of articulation. I am inclined to believe that actual articulation by the microphone is due mainly to the sudden and violent changes disclosed in Professor Blake's diagrams of the motion of the diaphragm, and in Professor Meyer's diagram of the resultant curve of six harmonic sounds. Taking the latter as an example, I notice in what would be each single vibration of the diaphragm four momentary reversals of motion. The effect of these would be so overpowering upon the telephone that I believe no other variation in the motion of the diaphragm during a single vibration would have any chance to be heard. I therefore consider these to be the elements of articulation contained in the resultant curve *c d*. These arrests and reversals of motion may, I believe, be produced by the microphone by exceedingly small interruptions of current. In the case of magneto transmission the same elements of articulation in the motion of the diaphragm would produce reversals of current or "pulsations" and not "undulations," as defined in patent number 174,465.

94 x-Int. Then isn't it true that the magneto transmitter and the microphone transmitter operate substantially alike in the effect which they produce upon the current; that is, when the vibrations of the diaphragm are violent the current is violently affected and thereby imitates the action of the air vibrations producing the sound?

A. Yes, substantially alike in that effect.

95 x-Int. And isn't it also true that in the magneto transmitter the reversals of the movement of the diaphragm, whether those are momentary in the course of a whole vibration or at the end of a whole vibration are followed by a reversal of the current on the line, and of necessity a stoppage of the current at the instant of reversal, just as the air particles in their pendulous swing stop and are reversed either momentarily in the course of a single swing or at the end of each swing; whether you call that action undulatory or by any other name you may choose to invent?

A. The resemblance holds in so far as the diaphragm is able to copy the motions of the air. I think the best observations show that the diaphragm never takes up or reproduces the greater part of the small vibrations due to composite sounds.

96 x-Int. And does the diaphragm of the microphone transmitter differ in this respect from the magneto?

A. It does not.

97 x-Int. Now suppose a rectangular block of carbon about three inches square and about an inch thick laid upon another similar block, having the faces in contact plane and ground together so as to be polished, and suppose a battery current to be passed into one of those blocks and out of the other, having a Bell receiver in circuit. Now, supposing the blocks laid upon a table, with their planes of contact horizontal, and a person with his mouth directly above the upper block to speak to it in an ordinary voice, which will be heard at the receiver. Would you say that that telephone operated by diminishing and increasing the resistance of the circuit merely, or that this apparatus did in fact break the circuit by minute breaks?

A. The mere fact that the contact is of plane or polished surfaces does not settle at all the question of what may be called electrical contact, and varies it but little or only quantitatively from the same question as to the contact of two rough pieces of carbon. The multiplication of the points of contact is a chief difference. Supposing the voice to be heard, it might take place through any of the causes of variation or interruption referred to. Pressure would probably be a prominent one.

98 x-Int. Then you mean to swear, do you, that in your opinion, under the circumstances stated, the block of carbon weighing about three-quarters of a pound would probably jump up, when spoken to, and break the electric current momentarily?

A. We are speaking of motion so exceedingly small that the phrase "jump up" might be misleading. The recoil from the pressure of each vibration may be an effectual interruption of the current.

99 x-Int. Do you mean to say that in your opinion, in the supposed case the current is broken by the separation of the electrodes? I do not ask you what may be true, but whether you believe it is true?

A. In those exceedingly small spaces which we ordinarily call contact, I mean the space between the opposing surfaces of the electrodes, it is very difficult to tell what passes. There is reason to believe that an exceedingly thin intervening film of air is a conductor. There is uncertainty therefore as to what constitutes interruption. I have no doubt that parts of the opposing surfaces of

electrodes in process of transmission are undergoing interruption and renewal of the circuit, very much as if they were independent conductors; and I think that in the great crises of vibration the effect of general interruption probably takes place.

100 x-Int. Won't you answer the question; which is, whether you believe that the three-quarter pound of carbon, when spoken to under the circumstances mentioned, does in fact separate itself from the opposite block, so that the electric current ceases to flow?

A. Supposing speech to take place under those circumstances, while I have no positive belief in the matter, I think interruption is likely to take place. I think the matter of the weight of the block has comparatively little to do with it, the weight being sufficient to keep the two in contact.

101 x-Int. That is, in your opinion, when this three-quarters of a pound of carbon is spoken to, it will so far separate itself from its opposite electrode as that the current cannot flow across the gap. Do you really believe that to be true?

A. If the voice moves this mass of carbon, or the particles of which it is composed, the concussion of each vibration, for all that I or any one knows to the contrary, may be sufficient to interrupt the electric current in the almost infinitessimal spaces which we are considering. The whole matter, however, is largely one of supposition.

102 x-Int. I repeat the question, and I do not ask you for your suppositions, and I do not assume that the voice moves the block of carbon. I only ask whether you believe it to be true, that when that block of carbon is spoken to, it actually separates itself from the underlying electrode so far that the electric current will not flow through that joint?

A. I have no positive *knowledge* or belief in the matter.

103 x-Int. Haven't you a positive belief that the variation in question produced by the air waves beating on the carbon block are entirely sufficient to account for the variations in the electric current resulting in the transmission of speech; without assuming that this three-quarter pound block recoils so far as to break the current?

A. The variation of pressure produced by the air waves may include interruption among its effects, and I do not assume necessarily that the mass of the three-quarter pound block is lifted in a recoil which might break the current.

104 x-Int. Won't you answer the question; which is as to your belief?

A. Yes; with the explanation of pressure, which I have just given.

105 x-Int. Do you mean by that to say that you believe it to be true that the variations of pressure are not sufficient to account for the transmission of speech under the circumstances mentioned, unless those variations include among their effects the actual breaking of the electric current, whether that rupture is occasioned by the recoil of the block or by some mysterious and unexplained phenomenon?

A. I do not.

106 x-Int. Isn't it desirable in microphone transmitters to so construct and adjust them that the electric current will not be broken when the diaphragm is spoken to, and are there not various patents taken for devices for the avowed purpose of preventing such rupture?

A. It is desirable there should be no makes and breaks occupying the space of a single vibration of the diaphragm. Various devices are used, patented and unpatented, to prevent such breaks. This does not apply to the lesser arrests or reversals of motion, which, I think, are concerned in the function of articulation. I will add, for the sake of accuracy, that in the class to which the Exhibit Defendants' Transmitter belongs, the microphone action seems to consist in innumerable makes and breaks; the aggregate effect of which is the abrupt changes represented in the tracings of Professor Blake.

107 Cross-Int. Do you mean to say, for the sake of accuracy or otherwise, that microphone transmitters produce the abrupt changes represented in tracings of Professor Blake, and that magneto transmitters do not produce such abrupt changes?

A. I do not.

108 x-Int. In the defendants' transmitter there are sixteen independent paths by which the current may flow; any two of which being on opposite sides of the apparatus are sufficient. Is not that so?

A. I think a larger number is better, and I have understood that they have gradually increased the number which they have employed.

109 Cross-Int. But any two on opposite sides of the centre are sufficient for the transmission of speech, are they not?

A. They are.

110 x-Int. And isn't it certain that the multiplication of these paths, standing as they do at varities of angles to the horizon, increases the probability that they will be one uninterrupted conductor, and diminishes the probability of a circuit breaking?

A. Where the contacts are so loose and so exceedingly imperfect, it seems to be an advantage to have as many makes and breaks as possible. By increasing the number of pieces there is better contact when made, and, I think, a probability of more contacts and more continuous contact.

111 x-Int. But if the object was to make the instrument a circuit breaker, that object would be counteracted by increasing the number of spokes, would it not?

A. Yes, if by circuit breaker is meant the making and breaking of the circuit at each vibration.

112 x-Int. And if the object was to make and break the circuit at any other time than at the end of each vibration, wouldn't that object be as certainly counteracted as in the other case, by increasing the number of spokes and thereby increasing the number of independent channels for the flow of the current, so that in order to interrupt the flow of the current at all, all of the contacts must at the same time be broken?

A. In my previous answer I did not refer necessarily to breaking the circuit at the end of each vibration. As regards minute articulating interruptions of the current within the limits of a single vibration, it will be a matter of experiment to ascertain when the precise point was reached of copying by the microphone such interruptions of circuit. It might be more accurately accomplished by a smaller or larger number of spokes. An increase of the number of spokes would, in general terms, increase the continuity of the current.

113 x-Int. Is it a matter of experiment to say whether or not an increase of spokes in this apparatus would diminish or increase the probability that the electric current would be ruptured during the transmission, whenever or however that rupture should take effect?

A. An increase of the number of spokes would diminish the probability of rupture of the electric circuit.

114 x-Int. I notice in your account of your experiments with the different Reis apparatus you give no account of any experiment, as far as I see, in which you used any transmitter and receiver that are found described as pairs in any of the articles. Did

you omit to state any such fact, if it existed, or did you make no such trial?

A. I used one or more Reis transmitters in combination with one or more Reis receivers. I took no particular pains in pairing them or in specially assorting them.

115 x-Int. As you have expressed very positively several opinions on patent law, during this examination, I should like to know whether, as you understand the patent law, you supposed when you made those experiments, a patent could be defeated by selecting one part of an apparatus found in one publication and uniting it with another part of another apparatus found in another publication, in order to show that the invention was thereby anticipated?

Objection, that the patent law knowledge of the witness is not material.

A. I do not think that the supposition entered my mind at all.

116 x-Int. I also observe that your Reis cubical box transmitter had "a scrap of carbon on the contact point," when you experimented with it. Did you think that if you put that scrap of carbon on the contact point you were following Reis' description and repeating his experiment; and didn't you know that you were introducing a valuable element into the machine for which you had no warrant in the publications, and which you were trying to prove to the Court you were making a talking apparatus?

A. I put a scrap of carbon weighing probably not more than one or two grains on the platinum point of one of the Reis transmitters in one or two experiments, for the purpose of showing how little was needed to make a perfect speaking telephone of such transmitter in combination with the Reis-Legat receiver. I did not know nor believe that it was described by Reis as part of his telephone, but I knew that I was introducing, to that extent, a new and valuable element.

117 x-Int. Why didn't you try the experiment with Reis' apparatus as constructed and operated as described by him in his report to the Physical Society at Frankfort, in 1861, and which you have testified, in this case, exhibited a successful microphone telephone?

A. So far as I remember, and so far as I understand the question,

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I employed the apparatus as described by him, excepting as to the talking adjustment which he must have used in obtaining articulate speech and which is not referred to in the article in question.

118 x-Int. The apparatus referred to in that article consists of a cubical block of wood, with a diaphragm at one end of the conical hole bored through it, and a spiral known as the needle receiver, a drawing of which is found in the Reis-Pisco Article. Now, did you use that combination without any alteration or changes, and were you enabled to hold up a conversation through it?

A. I remember experimenting with those instruments as described, I cannot separate the results in my memory from the results of other experiments detailed in my direct examination.

119 x-Int. Was the block transmitter just like the drawing in the Reis publication in all respects, or were there some additions to it?

A. It was, to the best of my knowledge.

120 x-Q. Could you transmit an intelligent sentence through it?

A. Without referring to my direct examination, I cannot answer whether I did or not. I will add that I consider it the best of the Reis transmitters.

121 x-Int. Do you consider that pair to constitute the best telephone of all those described in the Reis publications?

A. I consider the bored block and the Reis-Legat receiver to be the best Reis telephone.

122 x-Int. Where do you find in the publications any statement that that combination constitutes a telephone?

A. I don't know of any such specific statement.

Adjourned till June 25th, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

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29 WALL STREET, New York,
June 25th, 1884, 11 A. M.

Parties met pusuant to adjouanment.

Present—MR. DICKERSON, for complainants.
MR. PECKHAM, for defendants.

123 x-Int. In your direct examination you say that "the theory of Reis repeatedly stated is the copying by the receiving instrument

of the vibrations communicated by the transmitting instrument." Now isn't it the theory of Reis, repeatedly stated, that the effect proposed to be propuced is by making and breaking the electric current at each vibration of the transmitting diaphragm?

A. The theory of Reis to which I refer, is expressed in the following extracts from the article by Philipp Reis, published in the yearly report of the Physical Society at Frankfort-on-Main, 1860–1: "The extraordinary results in the field of telegraphy have probably "often raised the question if it might not be possible to transmit "speech itself to a distance." * * * "How indeed could a sin- "gle instrument produce the combined effect of all the organs occu- "pied in human speech? This was always the cardinal question; "finally I got the notion of putting the question in another way— "how does our ear appreciate the totality of vibration produced by "the organs of speech, all simultaneously active? Or more gener- "ally—how do we appreciate the vibrations of several simultane- "ously sounding bodies?" * * * "What our auditory nerve "perceives, is then, simply the action of a force coming within the "range of consciousness and this force can be represented both as to "duration and magnitude by a curve, graphically. Let *a b* represent "any given time and the curve above the line condensation ( ), "the curve below the line rarefaction (—), then any ordinate raised "from the end of any abscissa will represent the degree of conden- "sation, at the time represented by its base, in consequence of "which the drum of the ear vibrates.

"*a* *b*

"our ear can under no circumstances appreciate more than can be "represented by the curves, and this indeed is entirely sufficient to "give us a clear perception of any sound or any combination of "sounds.

"If several sounds are produced at the same time the conduct- "ing medium is subjected to the influence of several simultaneous "forces, and the two following laws will hold good: If the forces "act in the same direction, the amplitude is proportional to the sum "of the forces. If the forces act in opposite directions, the apli- "tudes are prodortional to the differences of the opposing forces.

"If, for example, in the case of three sounds, we draw the curve "of condensation of each separately by a summation of the ordi- "nates of corresponding abscissas, we can determine new ordinates "and develop a new curve, which might be called the combination

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"curve. This represents exactly what our ear perceives of three "simultaneous sounds." * * *

"As soon then as it is possible to produce, anywhere and in any "manner, vibrations whose curves shall be the same as those of any "sounds or combinations of sounds, we shall receive the same im- "pression as that sound or combination of sounds would have pro- "duced. With the above principles as a foundation, I have suc- "ceeded in constructing an apparatus with which I am enabled to "reproduce the sounds of vibrating instruments, and even to a cer- "tain extent the human voice." * * *

"Hitherto it has not been possible to reproduce human speech "with a distinctness sufficient for every one. The consonants are, "for the most part, reproduced pretty distinctly, but the vowels as "yet not in an equal degree."

Also the following extract from the Reis-Legat article, published in the Journal of the German-Austrian Telegraph Association, v. 9, p. 125, 1862:

"The apparatus described hereafter offers the possibility of pro- "ducing these vibrations in every manner desired, and by the use "of galvanic electricity it is possible to evoke, at any distance, "vibrations corresponding to those which have been so produced, "and in this way to reproduce at any place the sounds which have "been generated at another place."

After describing the construction and operation of the Reis-Legat instruments the report continues:

"In consequence of this operation, an alternate demagnetization "and magnetization of the electro-magnet of the apparatus, Fig. 4 "B is produced, resulting from the condensations and rarefactions "of the air in the tube *a b* of the apparatus, Fig. 4 A, and thus vi- "brations corresponding to the vibrations of the membrane in the "transmitting apparatus are induced in the armature of the magnet. "But the plate *i*, attached to the armature, communicates those "corresponding vibrations of the armature to the air surrounding "the apparatus, Fig. 4 B, which accordingly transmits the vibra- "tions so produced to the ear of the listener."

It will be seen from the above quotations that the theory of Reis as to sound and its electrical transmission is the copying by the receiving instrument of the vibrations communicated by the transmitting instrument, anticipating substantially the theory of sound and its so-called undulatory transmission contained in Letters Patent No. 174,465 of A. Graham Bell.

The quotations I have just made from the article of Reis "On Telephony by Means of the Galvanic Current" apply to the whole ground of the transmission of speech or of music, by any action of which his instruments are susceptible. The quotation from Legat follows a statement of the operation of the Reis-Legat instruments, which he described as making and breaking the electric current at each vibration of the diaphragm. This was a theory of Reis several times stated concerning the operation of his instruments; but even if it was a mistaken explanation of his, or intended by him to apply to all uses of his instruments, it cannot affect their actual operations when transmitting speech.

124 x-Int. Isn't there a substantial and radical difference in the mode of operation and in the effect produced between two instruments for the transmission of sound, one of which makes and breaks the electric current at each sound wave, and the other of which maintains a closed circuit unbroken and transmits sound by controlling the electrical current as it flows, so that its undulations, or vibrations, or pulsations (by whatever name you choose to describe its action) shall correspond with approximate accuracy to the vibrations, or pulsations, or undulations of the air which beats upon the diaphragm?

A. There is an immense difference between such instruments. My answer referred to the substantial agreement between Reis and Bell as to the theory of sound and its electrical transmission.

125 x-Int. You have sworn in your 123d answer, as I understand it, that Reis in his publications anticipated the so-called undulatory transmission contained in Bell's patent, by describing that mode of operation in his printed publications. As this is the first time, to my knowledge, that any expert in any of the trials has made that assertion, and as it is a fact of great importance, if it be true, I ask you to point out in those publications a single sentence in which it is stated that speech may be transmitted by the mode specified in Bell's patent, whether you use the language of Bell's patent to express that mode or whether you adopt the expression that the streneth of the current must vary continuously and as nearly as may be in simple proportion to the velocity of a projectile of air engaged in constituting the sound, which is Sir William Thomson's statement of the operation?

A. I stated in my answer to the 123d cross-interrogatory that the theory of Reis, as shown in preceding extracts, anticipated substantially the theory of sound and its undulatory transmission

in the Bell patent, and not that Reis anticipated the special method used by Bell of electrically copying by the receiving instrument the vibrations communicated by the transmitting instrument.

126 x-Int. Now, point out to the Court one word in the Reis publication suggesting that the electrical impulse was to have any other character than that of the electric telegraph, in which the circuit was made and broken alternately, or that while the current was flowing between the breaks it was to be modified or controlled in any way whatever?

A. I do not know of any specific statements of that kind. The extracts which I have made are full of suggestions that the electric current was employed by Reis for copying by the receiving instrument the sound vibrations communicated by the transmitting instrument.

127 x-Int. Point out any one suggestion out of those of which you say these articles are full, which indicates or suggests that the electric current, while flowing shall be controlled to correspond with the motion of the air waves. I do not ask for any specific statement to that effect, but for a hint or suggestion of that kind?

A. I quote the following statement of Reis from the extracts which I have already given.

Preceding the description of his bored block transmitter, which I know by experience to be, when in good condition, a perfect articulating transmitter, and in immediate connection with this description, he says: "As soon then as it is possible to produce anywhere and in any manner, vibrations whose curves shall be the same as those of any sounds or combinations of sounds, we shall receive the same impression as that sound or combination of sounds would have produced."

I also quote from the Reis-Legat article already referred to, the following: "An alternate demagnetization and magnetization of the electro-magnet of the" (receiving) "apparatus, Fig. 4 B is produced resulting from the condensations and rarefactions of the air in the tube *a b* of" (transmitting) "apparatus, and thus vibrations "corresponding to the vibrations of the membrane in the transmit-"ting apparatus are induced in the armature of the magnet. But "the plate *i* attached to the armature communicates these corre-"sponding vibrations of the armature to the air surrounding the "apparatus Figure 4 B, which accordingly transmits the vibrations "so produced to the ear of the listener."

This is the statement of the general principle of the electrical transmission of sound, or of the theory of its transmission in the Reis telephone, and the best statement of it with which I am acquainted. It follows, as I have already taken care to state, Legat's description of a special make and break operation of the apparatus.

128 x-Int. And don't you know it to be true that that best statement known to you of Reis' operation by Legat is a perfectly exact statement of the mode of operation of an ordinary Morse key and sounder, so far as the electrical operation is concerned? That is, when the circuit is made and broken at the transmitting end, there is an alternate demagnetization and magnetization of the electro-magnet of the Legat receiver, which is substantially a Morse sounder?

A. That best statement known to me was not of Reis' operation by Legat, but of the general principle of the electrical transmission of sound or of the theory of its transmission in the Reis telephone.

129 x-Int. Then I repeat the question. Is not that best statement of the theory of the transmission of sound in the Reis telephone a rigorously exact statement of the theory of the transmission of signals by the Morse telegraph; which is, that the circuit is made and broken at the transmitting end, and an alternate demagnetization and magnetization of the electro-magnet, in the apparatus, Figure 4 B, (which is substantially an ordinary Morse sounder) is produced?

A. It is not. In the first place the receiving apparatus Figure 4 A, which is the Reis-Legat electro-magnetic receiver, is not substantially a Morse sounder, as it carries a "plate," so named in the above extract, for the purpose of communicating the vibrations of the armature to the air surrounding the apparatus. It is not a rigorously exact statement of the theory of the transmission of signals by the Morse telegraph, as the Morse key has no relation to telephonic condensations and rarefactions of the air, which may or may not result in making and breaking the circuit.

130 x-Int. Is it not exactly true, that so far as the electrical action is concerned, the Legat receiver is an ordinary Morse sounder, and could be substituted on a telegraph line to perform the work of a sounder, without any change whatever in its construction, and that the addition of the plate, as it is called, to the armature lever of the Morse sounder does not alter its electrical or magnetic action at all?

A. As far as its electro-magnet and simple armature is concerned, it might be used as a sounder, as almost any other electro-magnet and armature might. The character of its adjustments would, in my opinion, make it exceedingly difficult, if not ordinarily impossible, to use it as a sounder. I give this merely as an opinion from a momentary examination, without experiment.

131 x-Int. Isn't the Morse sounder a combination of an electro-magnet, a suspended armature, an adjustable retractile string to hold the armature back until the magnetic force attracts it, and a stop or stops to limit the vibration of the armature? If the Morse sounder has any other parts than those, tell what they are?

A. A Morse sounder is variously constructed; I should say that it generally had two adjustable stops to limit the motion of the armature in both directions. Also these stops are so connected with resonant metallic supports as to give a sharp report of the to-and-fro movement of the armature. All of these may not be essentials to the Morse sounder.

132 x-Int. Won't you answer the question, which is this: Is not the ordinary Morse sounder composed of an electro-magnet (like *m m* in the Legat receiver,) a suspended armature suspended opposite the poles of the electro-magnet generally suspended from above, as in the Legat receiver, an adjustable retractile spring, generally made of a spiral wire, attached at one end to the armature lever, and at the other to a thumb screw, by which it may be slackened or tightened, one or two adjustable stops, similar to the adjustable stop *l* in the Legat receiver, whose function it is to limit the vibration of the armature and lever: the whole arranged upon a suitable base-board and supports for maintaining the parts in their respective positions. If you deny that these are the parts and the arrangements of an ordinary Morse sounder, then tell the Court what is superfluous or what is needed in order to truly describe that instrument?

A. In answer to cross-interrogatory 131, I enumerated parts not mentioned therein. In answer to cross-interrogatory 132, I should say that these were the parts generally included in the Morse sounder.

133 x-Int. Are any other operative parts essential; if so, name them?

A. I do not think of any others.

134 x-Int. Has not the Legat receiver that same combination of parts, arranged relatively in the same manner with addition thereto

of the extension of the armature lever above the pivot of suspension?

A. I should say that it lacked one of the armature stops, which I think is essential to give one of the sounds of the sounder, though this may be obtained possibly in practice by some equivalent, which I do not find in the Reis receiver. The Reis receiver also has not, I think, the system of solid metallic supports to which I have before referred.

I should say generally that it had the same combination of parts, with these exceptions.

135 x-Int. Isn't it necessary in the Legat receiver to have some stop to arrest the vibration of the armature towards the magnet?

A. Nothing more than the spring that is usually provided.

136 x-Int. And you think, do you, that that thing would operate without any stop to limit its vibration towards the magnet?

A. I have heard it talk exceedingly well with nothing but the spring to limit the motion of the armature toward the magnet, as represented in "Fig. 4 B," already referred to.

137 x-Int. Was the armature in contact with the magnet at that time?

A. It was not.

138 x-Int. Was it in contact with the back-stop?

A. The plate which carries the armature was strongly in contact with the back-stop, by the action of the spring.

139 x-Int. Under those circumstances, the strength of the current wasn't sufficient to overcome the spring; wasn't that true?

A. Certainly.

140 x-Int. Was that the operation described in the Legat article; and don't you know that it was not?

Adjourned till June 27th, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

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29 WALL STREET, NEW YORK,
June 27, 1884, 11 A. M.

Met pursuant to adjournment.

Present—MR. DICKERSON, for Complainants, MR. PECKHAM, for Defendants.

CROSS-EXAMINATION OF WILLIAM F. CHANNING CONTINUED BY MR. DICKERSON:

140 x-Int. Read to witness.

A. I understand that that arrangement of magnet and armature is exactly that described in the Reis-Legat article, which states that the motion of the lever *i* with the armature is regulated by means of the screw *l* and the spring *q*. All my preceding references from the Reis-Legat article are from the Exhibit Translation in the Spencer Record.

141 x-Int. You have sworn that when you tried your experiments with the Legat receiver, "the plate which carries the armature was strongly in contact with the back-stop by the action of the spring," and that "under those circumstances the strength of the current was not sufficient to overcome the spring."

Now, I ask you whether you don't know that that condition of the apparatus when in operation is not the condition of operation described in the Legat article?

A. By the word "overcome" in my answer, I meant that the strength of the current was not sufficient to force the armature into contact with the magnet against the operation of the spring. Not of course that the current was insufficient to vibrate the armature in its position opposite the poles of the magnet. The armature in this case is the equivalent of the diaphragm in the modern magneto receivers, which is elastically held in front of the pole of the magnet, free to vibrate, but not subject to sufficient magnetic force to bring it into contact with the magnet.

142 x-Q. You swore that "the plate which carries the armature was strongly in contact with the back-stop by the action of the spring," when you tried your experiments. Now was that true or not?

A. It was true. The back-stop is what is called in the quotation made by me above, "the screw *l*." This back-stop, or screw *l*, bears on the elastic armature lever or plate so high up as to allow to the armature and plate ample freedom of vibration.

143 x-Int. Then, as you understand the operation described in the Legat article, it was not the intention to vibrate the plate at the lower end of which the armature is attached around the centre of suspension, in the manner of the pendulum, its motion being regulated by means of the screw *l* and the spring *q*, but it was to screw the plate hard up against the stop and not permit it to vibrate in the manner of a pendulum. Do you mean to tell the Court that that is your understanding of that operation, as described in the article?

A. The operation of the armature and lever plate, as described in the article, seems to me capable of only one construction. The lever plate which carries the armature is suspended in the manner of a pendulum, and its motion is regulated by a stop, or screw, and a spring. It is not free to vibrate like a pendulum, and the theory of its vibration involves two solid points of contact and one elastic point. The two solid bearings or points of contact are near the center of the elastic lever plate and do not interfere with the vibrations corresponding to articulate sounds, any more than the solid circumferential contact of the diaphragm plate in the modern form of receiver.

144 x-Int. Won't you answer the question specifically, yes or no, without an argument or a comparison with the Bell instrument, which is this: Do you mean to swear that, in your opinion, the operation of the receiver described in the Legat article is, that the plate should be strained up against the stop *l* by the screw and spring, so that in operation the plate should not come away from the stop in the manner of the pendulum, but should remain strained up hard against it?

A. I cannot answer the question without qualifying some of its terms. The only way, in my opinion, in which the stop *l* can regulate the motion of the lever plate, if it is to act constantly, is by resisting the action of the spring; and it is, therefore, my opinion that the lever plate must be strained against the stop *l* by means of the spring with sufficient force to hold it in position there.

145 x-Int. I haven't asked you your opinion on the question how the stop can regulate the motion of the lever plate in order to make the instrument perform what you heard it do with your present knowledge of the subject. The question is a very simple one, and I ask an answer, yes or no. Does that article instruct the user of the apparatus that the plate and armature are not to swing to-and-fro with a motion limited by the stop in one direction, but that

he is to strain up the plate against the stop so that it cannot move away from it when in use, and use it in that condition?

A. The question as asked seems to me a very complicated one, and insusceptible of an answer, yes or no.

The instruction given to the user of the apparatus by the description and accompanying figure is, that the lower part of the plate and armature are to swing to and fro with a motion limited by the stop, and that the user is to draw up the plate against the stop, so that it will not move away from it when in use. This I believe to be a correct statement.

146 x-Int. Point out to the Court where that instruction is given, and quote the language that gives it?

A. I think it is shown in the Fig. B, to which I have referred, and also in the words which I have already quoted, namely, that the motion of the lever with the armature is "regulated by means of the screw *l* and the spring *q*."

The whole quotation is this: "The lever *i* with the armature is "suspended from the standard *k* in the manner of a pendulum, its "motion being regulated by means of the screw *l* and the spring *q*." The figure and those words together seem to me to leave no doubt of the method of operation.

147 x-Int. In the apparatus which you made and in which the armature *k* was strained up against the stop, about how far was the armature set from the face of the magnet?

A. I cannot remember with any accuracy. I should say it was as near to the magnet as it could conveniently be without being drawn in contact with it by the magnetic force. Probably the armature was nearer to the one pole than to the other.

148 x-Int. Did the armature touch one pole?

A. It did not, unless accidentally.

149 x-Int. Was the armature as much as a sixteenth of an inch from one of the poles in its normal condition?

A. I should think so.

150 x-Int. Was it an eighth of an inch from it when adjusted for work?

A. I should think not, generally.

151 x-Int. In the drawing the retractile spring, as I measure it, is represented as one inch long, the drawing being one-third of natural size, which please verify and say whether I am correct. If not, give the true length of that spring, the drawing representing a scale of one-third?

A. It is about one inch in length; possibly an inch and one sixteenth.

152 x-Int. Now, will you be good enough to tell the Court how a spiral spring is to be constructed more than an inch long to hold back an armature less than an eighth of an inch from the face of the magnet, which would permit that magnet to draw the armature a part of the way towards the face of the magnet and then arrest it; and where, in that article, you get the instructions to make such a spring? I ask this question in view of the law, that the magnetic force increases as the squares of the distance between the armature and the magnet diminish, and that any movement of the armature, however slight, will enormously increase the attractive force. When you answer this question, tell the Court whether, in the electric art, you know of any apparatus in use in 1862 in which any such adjustment of a spring an inch long controlling an armature less than an eighth of an inch from the magnet is made, and what that instrument was?

A. A spiral spring for such a purpose would be made more or less stiff, according to the magnetic force which it would have to resist, and according to the extent of the vibration required of the armature. In this case, the spring is necessarily very rigid. The degree of rigidity of a spring, in the case of a figure representing an electro-magnetic apparatus, so far as I know, is always inferred from the drawing and the description of the general operation of the apparatus. I do not remember ever to have seen instructions relative to the precise character of such a spring beyond such information. There are no instructions in this article to make such a spring. I do not remember the particular length of any springs in any apparatus in 1862. The vibrations of the armature in this case are exceedingly minute in comparison with the distance between the armature and the poles of the magnet.

153 x-Int. Now, don't you believe it to be true, that, in an apparatus such as shown on that drawing, with a spiral spring more than an inch long, and the movement of the armature less than an eighth of an inch, if the attractive force were sufficient to elongate the spring and bring the armature nearer to the magnet in the first instance, it would be stong enough, by reason of its enormous increase, to carry the armature to the face of the magnet?

A. Not necessarily. As answered before, those vibrations are excessively minute compared with the distance between the armature and the poles of the magnet; so that the increase of force,

within the limits of a vibration, is not so very great; and also the attraction between the armature and the magnet is not continuous, but intermittent, allowing the spring to counteract the momentary force of the magnet. Practically, I know that under such circumstances, and with an instrument so constructed and adjusted, the armature vibrates freely under the influence of the magnet to and fro, without being drawn into contact with it.

154 x-Int. As I read your direct examination, you did not use the entire apparatus described in the Legat Article, but only the receiver in connection with some other sort of transmitter. Now, did you use five cells of battery on that receiver, as shown in the drawing, to charge the electro-magnet? Or did you use a weaker battery power?

A. I do not see in the record of the experiments in my direct examination a statement of the number of cells employed. In the course of the experiments we used different numbers, sometimes five, sometimes less, and I think sometimes more.

155 x-Int. But, in any case, when you were not talking to the transmitter, the full power of the battery was upon the electro-magnet; was it not? The current flowing and the magnet being saturated?

A. The circuit at such time was complete, the electrodes being in contact.

156 x-Int. Under those circumstances, the element of the minute duration of the current not existing, wasn't the spring strained up so hard that the armature could not go to the magnet?

A. It was.

157 x-Int. Under those circumstances, did the magnet draw the armature a part of the way from its normal position, and not all the way, the spring preventing, and there being no limited time; which was one of the reasons you gave in your former answer why the magnet did not overcome the spring?

A. It undoubtedly did; the intermitted attraction, in the case of vibration, being only one reason why the armature should not be drawn into contact with the magnet.

158 x-Int. Then, isn't it certain that the proportions of that spring must have been very different from those shown in the drawing, and that such a spring as was there used was made on purpose to produce that sort of effect?

A. I see no reason why the proportions of the spring should be at all different from those shown in the figure, and do not understand it to have been so, unless accidentally.

159 x-Int. If the armature moved to and fro, did you ascertain how much?

A. My only means of ascertaining was by comparing the vibration by the sense of touch, with that of the ferrotype diaphragm in the ordinary receivers, the extreme excursion of which I believe is stated by Prof. E. W. Blake at five one-thousandths of an inch. I do not think the vibration of the armature in the Reis-Legat receiver exceeds that of the ferrotype diaphragm.

160 x-Int. Was its motion visible at all?

A. I do not think I ever saw it move, except when it flew up to the magnet under just the same circumstances that the ferrotype diaphragm flies up to its magnet; that is, when the instrument is out of adjustment.

161 x-Int. But you think, do you, that when the author of the article wrote that "The lever *i* with the armature, is suspended from the standard *k* in the manner of a pendulum, its motion being regulated by means of the screw *l* and spring *q*, he meant to inform the world that the center of suspension, in the manner of a pendulum, was to be used as a straining point for a lateral thrust, and that the motion of this armature, suspended in the manner of a pendulum, was to be an invisible movement, and that the screw *l* was not for the purpose of stopping the swing of the pendulum in one direction, but was to be a straining point only, over which the armature lever was to be strained so that the magnet could not overcome the power of the spring and make the armature lever swing away from the stop in the manner of a pendulum?

A. I doubt if he had any such meaning. I think he meant merely that the armature was suspended in the manner of a pendulum, but that he did not mean that it swung as a pendulum, its motion being regulated by means of a stop and of a spring strong enough to prevent any but excessively minute vibrations.

162 x-Int. If those ideas which you have expressed as the intention of the writer of this article are not contained in the two and a half lines which I have quoted, are they contained anywhere else? If so, point them out?

A. I think those ideas which I have expressed are the obvious meaning of the two and a half lines referred to in the question, taken in connection with the figure B, to which they directly apply, and in connection also with this quotation: "Thus vibrations cor-
" responding to the vibrations of the membrane in the transmitting
" apparatus are induced in the armature of the magnet."

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in the Bell patent, and not that Reis anticipated the special method used by Bell of electrically copying by the receiving instrument the vibrations communicated by the transmitting instrument.

126 x-Int. Now, point out to the Court one word in the Reis publication suggesting that the electrical impulse was to have any other character than that of the electric telegraph, in which the circuit was made and broken alternately, or that while the current was flowing between the breaks it was to be modified or controlled in any way whatever?

A. I do not know of any specific statements of that kind. The extracts which I have made are full of suggestions that the electric current was employed by Reis for copying by the receiving instrument the sound vibrations communicated by the transmitting instrument.

127 x-Int. Point out any one suggestion out of those of which you say these articles are full, which indicates or suggests that the electric current, while flowing shall be controlled to correspond with the motion of the air waves. I do not ask for any specific statement to that effect, but for a hint or suggestion of that kind?

A. I quote the following statement of Reis from the extracts which I have already given.

Preceding the description of his bored block transmitter, which I know by experience to be, when in good condition, a perfect articulating transmitter, and in immediate connection with this description, he says: "As soon then as it is possible to produce anywhere and in any manner, vibrations whose curves shall be the same as those of any sounds or combinations of sounds, we shall receive the same impression as that sound or combination of sounds would have produced."

I also quote from the Reis-Legat article already referred to, the following: "An alternate demagnetization and magnetization of the electro-magnet of the" (receiving) "apparatus, Fig. 4 B is produced resulting from the condensations and rarefactions of the air in the tube *a b* of" (transmitting) "apparatus, and thus vibrations "corresponding to the vibrations of the membrane in the transmit-"ting apparatus are induced in the armature of the magnet. But "the plate *i* attached to the armature communicates these corre-"sponding vibrations of the armature to the air surrounding the "apparatus Figure 4 B, which accordingly transmits the vibrations "so produced to the ear of the listener."

This is the statement of the general principle of the electrical transmission of sound, or of the theory of its transmission in the Reis telephone, and the best statement of it with which I am acquainted. It follows, as I have already taken care to state, Legat's description of a special make and break operation of the apparatus.

128 x-Int. And don't you know it to be true that that best statement known to you of Reis' operation by Legat is a perfectly exact statement of the mode of operation of an ordinary Morse key and sounder, so far as the electrical operation is concerned? That is, when the circuit is made and broken at the transmitting end, there is an alternate demagnetization and magnetization of the electro-magnet of the Legat receiver, which is substantially a Morse sounder?

A. That best statement known to me was not of Reis' operation by Legat, but of the general principle of the electrical transmission of sound or of the theory of its transmission in the Reis telephone.

129 x-Int. Then I repeat the question. Is not that best statement of the theory of the transmission of sound in the Reis telephone a rigorously exact statement of the theory of the transmission of signals by the Morse telegraph; which is, that the circuit is made and broken at the transmitting end, and an alternate demagnetization and magnetization of the electro-magnet, in the apparatus, Figure 4 B, (which is substantially an ordinary Morse sounder) is produced?

A. It is not. In the first place the receiving apparatus Figure 4 A, which is the Reis-Legat electro-magnetic receiver, is not substantially a Morse sounder, as it carries a "plate," so named in the above extract, for the purpose of communicating the vibrations of the armature to the air surrounding the apparatus. It is not a rigorously exact statement of the theory of the transmission of signals by the Morse telegraph, as the Morse key has no relation to telephonic condensations and rarefactions of the air, which may or may not result in making and breaking the circuit.

130 x-Int. Is it not exactly true, that so far as the electrical action is concerned, the Legat receiver is an ordinary Morse sounder, and could be substituted on a telegraph line to perform the work of a sounder, without any change whatever in its construction, and that the addition of the plate, as it is called, to the armature lever of the Morse sounder does not alter its electrical or magnetic action at all?

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A. As far as its electro-magnet and simple armature is concerned, it might be used as a sounder, as almost any other electro-magnet and armature might. The character of its adjustments would, in my opinion, make it exceedingly difficult, if not ordinarily impossible, to use it as a sounder. I give this merely as an opinion from a momentary examination, without experiment.

131 x-Int. Isn't the Morse sounder a combination of an electro-magnet, a suspended armature, an adjustable retractile string to hold the armature back until the magnetic force attracts it, and a stop or stops to limit the vibration of the armature? If the Morse sounder has any other parts than those, tell what they are?

A. A Morse sounder is variously constructed; I should say that it generally had two adjustable stops to limit the motion of the armature in both directions. Also these stops are so connected with resonant metallic supports as to give a sharp report of the to-and-fro movement of the armature. All of these may not be essentials to the Morse sounder.

132 x-Int. Won't you answer the question, which is this: Is not the ordinary Morse sounder composed of an electro-magnet (like *m m* in the Legat receiver,) a suspended armature suspended opposite the poles of the electro-magnet generally suspended from above, as in the Legat receiver, an adjustable retractile spring, generally made of a spiral wire, attached at one end to the armature lever, and at the other to a thumb screw, by which it may be slackened or tightened, one or two adjustable stops, similar to the adjustable stop *l* in the Legat receiver, whose function it is to limit the vibration of the armature and lever: the whole arranged upon a suitable base-board and supports for maintaining the parts in their respective positions. If you deny that these are the parts and the arrangements of an ordinary Morse sounder, then tell the Court what is superfluous or what is needed in order to truly describe that instrument?

A. In answer to cross-interrogatory 131, I enumerated parts not mentioned therein. In answer to cross-interrogatory 132, I should say that these were the parts generally included in the Morse sounder.

133 x-Int. Are any other operative parts essential; if so, name them?

A. I do not think of any others.

134 x-Int. Has not the Legat receiver that same combination of parts, arranged relatively in the same manner with addition thereto

of the extension of the armature lever above the pivot of suspension?

A. I should say that it lacked one of the armature stops, which I think is essential to give one of the sounds of the sounder, though this may be obtained possibly in practice by some equivalent, which I do not find in the Reis receiver. The Reis receiver also has not, I think, the system of solid metallic supports to which I have before referred.

I should say generally that it had the same combination of parts, with these exceptions.

135 x-Int. Isn't it necessary in the Legat receiver to have some stop to arrest the vibration of the armature towards the magnet?

A. Nothing more than the spring that is usually provided.

136 x-Int. And you think, do you, that that thing would operate without any stop to limit its vibration towards the magnet?

A. I have heard it talk exceedingly well with nothing but the spring to limit the motion of the armature toward the magnet, as represented in "Fig. 4 B," already referred to.

137 x-Int. Was the armature in contact with the magnet at that time?

A. It was not.

138 x-Int. Was it in contact with the back-stop?

A. The plate which carries the armature was strongly in contact with the back-stop, by the action of the spring.

139 x-Int. Under those circumstances, the strength of the current wasn't sufficient to overcome the spring; wasn't that true?

A. Certainly.

140 x-Int. Was that the operation described in the Legat article; and don't you know that it was not?

Adjourned till June 27th, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

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29 WALL STREET, NEW YORK,
June 27, 1884, 11 A. M.

Met pursuant to adjournment.

Present—MR. DICKERSON, for Complainants, MR. PECKHAM, for Defendants.

CROSS-EXAMINATION OF WILLIAM F. CHANNING CONTINUED BY MR. DICKERSON:

140 x-Int. Read to witness.

A. I understand that that arrangement of magnet and armature is exactly that described in the Reis-Legat article, which states that the motion of the lever *i* with the armature is regulated by means of the screw *l* and the spring *q*. All my preceding references from the Reis-Legat article are from the Exhibit Translation in the Spencer Record.

141 x-Int. You have sworn that when you tried your experiments with the Legat receiver, "the plate which carries the armature was strongly in contact with the back-stop by the action of the spring," and that "under those circumstances the strength of the current was not sufficient to overcome the spring."

Now, I ask you whether you don't know that that condition of the apparatus when in operation is not the condition of operation described in the Legat article?

A. By the word "overcome" in my answer, I meant that the strength of the current was not sufficient to force the armature into contact with the magnet against the operation of the spring. Not of course that the current was insufficient to vibrate the armature in its position opposite the poles of the magnet. The armature in this case is the equivalent of the diaphragm in the modern magneto receivers, which is elastically held in front of the pole of the magnet, free to vibrate, but not subject to sufficient magnetic force to bring it into contact with the magnet.

142 x-Q. You swore that "the plate which carries the armature was strongly in contact with the back-stop by the action of the spring," when you tried your experiments. Now was that true or not?

A. It was true. The back-stop is what is called in the quotation made by me above, "the screw *l*." This back-stop, or screw *l*, bears on the elastic armature lever or plate so high up as to allow to the armature and plate ample freedom of vibration.

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143 x-Int. Then, as you understand the operation described in the Legat article, it was not the intention to vibrate the plate at the lower end of which the armature is attached around the centre of suspension, in the manner of the pendulum, its motion being regulated by means of the screw / and the spring *q*, but it was to screw the plate hard up against the stop and not permit it to vibrate in the manner of a pendulum. Do you mean to tell the Court that that is your understanding of that operation, as described in the article?

A. The operation of the armature and lever plate, as described in the article, seems to me capable of only one construction. The lever plate which carries the armature is suspended in the manner of a pendulum, and its motion is regulated by a stop, or screw, and a spring. It is not free to vibrate like a pendulum, and the theory of its vibration involves two solid points of contact and one elastic point. The two solid bearings or points of contact are near the center of the elastic lever plate and do not interfere with the vibrations corresponding to articulate sounds, any more than the solid circumferential contact of the diaphragm plate in the modern form of receiver.

144 x-Int. Won't you answer the question specifically, yes or no, without an argument or a comparison with the Bell instrument, which is this: Do you mean to swear that, in your opinion, the operation of the receiver described in the Legat article is, that the plate should be strained up against the stop / by the screw and spring, so that in operation the plate should not come away from the stop in the manner of the pendulum, but should remain strained up hard against it?

A. I cannot answer the question without qualifying some of its terms. The only way, in my opinion, in which the stop / can regulate the motion of the lever plate, if it is to act constantly, is by resisting the action of the spring; and it is, therefore, my opinion that the lever plate must be strained against the stop / by means of the spring with sufficient force to hold it in position there.

145 x-Int. I haven't asked you your opinion on the question how the stop can regulate the motion of the lever plate in order to make the instrument perform what you heard it do with your present knowledge of the subject. The question is a very simple one, and I ask an answer, yes or no. Does that article instruct the user of the apparatus that the plate and armature are not to swing to-and-fro with a motion limited by the stop in one direction, but that

he is to strain up the plate against the stop so that it cannot move away from it when in use, and use it in that condition?

A. The question as asked seems to me a very complicated one, and insusceptible of an answer, yes or no.

The instruction given to the user of the apparatus by the description and accompanying figure is, that the lower part of the plate and armature are to swing to and fro with a motion limited by the stop, and that the user is to draw up the plate against the stop, so that it will not move away from it when in use. This I believe to be a correct statement.

146 x-Int. Point out to the Court where that instruction is given, and quote the language that gives it?

A. I think it is shown in the Fig. B, to which I have referred, and also in the words which I have already quoted, namely, that the motion of the lever with the armature is "regulated by means of the screw *i* and the spring *q*."

The whole quotation is this: "The lever *i* with the armature is "suspended from the standard *k* in the manner of a pendulum, its "motion being regulated by means of the screw *i* and the spring *q*." The figure and those words together seem to me to leave no doubt of the method of operation.

147 x-Int. In the apparatus which you made and in which the armature *k* was strained up against the stop, about how far was the armature set from the face of the magnet?

A. I cannot remember with any accuracy. I should say it was as near to the magnet as it could conveniently be without being drawn in contact with it by the magnetic force. Probably the armature was nearer to the one pole than to the other.

148 x-Int. Did the armature touch one pole?

A. It did not, unless accidentally.

149 x-Int. Was the armature as much as a sixteenth of an inch from one of the poles in its normal condition?

A. I should think so.

150 x-Int. Was it an eighth of an inch from it when adjusted for work?

A. I should think not, generally.

151 x-Int. In the drawing the retractile spring, as I measure it, is represented as one inch long, the drawing being one-third of natural size, which please verify and say whether I am correct. If not, give the true length of that spring, the drawing representing a scale of one-third?

A. It is about one inch in length; possibly an inch and one sixteenth.

152 x-Int. Now, will you be good enough to tell the Court how a spiral spring is to be constructed more than an inch long to hold back an armature less than an eighth of an inch from the face of the magnet, which would permit that magnet to draw the armature a part of the way towards the face of the magnet and then arrest it; and where, in that article, you get the instructions to make such a spring? I ask this question in view of the law, that the magnetic force increases as the squares of the distance between the armature and the magnet diminish, and that any movement of the armature, however slight, will enormously increase the attractive force. When you answer this question, tell the Court whether, in the electric art, you know of any apparatus in use in 1862 in which any such adjustment of a spring an inch long controlling an armature less than an eighth of an inch from the magnet is made, and what that instrument was?

A. A spiral spring for such a purpose would be made more or less stiff, according to the magnetic force which it would have to resist, and according to the extent of the vibration required of the armature. In this case, the spring is necessarily very rigid. The degree of rigidity of a spring, in the case of a figure representing an electro-magnetic apparatus, so far as I know, is always inferred from the drawing and the description of the general operation of the apparatus. I do not remember ever to have seen instructions relative to the precise character of such a spring beyond such information. There are no instructions in this article to make such a spring. I do not remember the particular length of any springs in any apparatus in 1862. The vibrations of the armature in this case are exceedingly minute in comparison with the distance between the armature and the poles of the magnet.

153 x-Int. Now, don't you believe it to be true, that, in an apparatus such as shown on that drawing, with a spiral spring more than an inch long, and the movement of the armature less than an eighth of an inch, if the attractive force were sufficient to elongate the spring and bring the armature nearer to the magnet in the first instance, it would be strong enough, by reason of its enormous increase, to carry the armature to the face of the magnet?

A. Not necessarily. As answered before, those vibrations are excessively minute compared with the distance between the armature and the poles of the magnet; so that the increase of force,

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within the limits of a vibration, is not so very great; and also the attraction between the armature and the magnet is not continuous, but intermittent, allowing the spring to counteract the momentary force of the magnet. Practically, I know that under such circumstances, and with an instrument so constructed and adjusted, the armature vibrates freely under the influence of the magnet to and fro, without being drawn into contact with it.

154 x-Int. As I read your direct examination, you did not use the entire apparatus described in the Legat Article, but only the receiver in connection with some other sort of transmitter. Now, did you use five cells of battery on that receiver, as shown in the drawing, to charge the electro-magnet? Or did you use a weaker battery power?

A. I do not see in the record of the experiments in my direct examination a statement of the number of cells employed. In the course of the experiments we used different numbers, sometimes five, sometimes less, and I think sometimes more.

155 x-Int. But, in any case, when you were not talking to the transmitter, the full power of the battery was upon the electro-magnet; was it not? The current flowing and the magnet being saturated?

A. The circuit at such time was complete, the electrodes being in contact.

156 x-Int. Under those circumstances, the element of the minute duration of the current not existing, wasn't the spring strained up so hard that the armature could not go to the magnet?

A. It was.

157 x-Int. Under those circumstances, did the magnet draw the armature a part of the way from its normal position, and not all the way, the spring preventing, and there being no limited time; which was one of the reasons you gave in your former answer why the magnet did not overcome the spring?

A. It undoubtedly did; the intermitted attraction, in the case of vibration, being only one reason why the armature should not be drawn into contact with the magnet.

158 x-Int. Then, isn't it certain that the proportions of that spring must have been very different from those shown in the drawing, and that such a spring as was there used was made on purpose to produce that sort of effect?

A. I see no reason why the proportions of the spring should be at all different from those shown in the figure, and do not understand it to have been so, unless accidentally.

159 x-Int. If the armature moved to and fro, did you ascertain how much?

A. My only means of ascertaining was by comparing the vibration by the sense of touch, with that of the ferrotype diaphragm in the ordinary receivers, the extreme excursion of which I believe is stated by Prof. E. W. Blake at five one-thousandths of an inch. I do not think the vibration of the armature in the Reis-Legat receiver exceeds that of the ferrotype diaphragm.

160 x-Int. Was its motion visible at all?

A. I do not think I ever saw it move, except when it flew up to the magnet under just the same circumstances that the ferrotype diaphragm flies up to its magnet; that is, when the instrument is out of adjustment.

161 x-Int. But you think, do you, that when the author of the article wrote that "The lever *i* with the armature, is suspended from the standard *k* in the manner of a pendulum, its motion being regulated by means of the screw *l* and spring *q*, he meant to inform the world that the center of suspension, in the manner of a pendulum, was to be used as a straining point for a lateral thrust, and that the motion of this armature, suspended in the manner of a pendulum, was to be an invisible movement, and that the screw *l* was not for the purpose of stopping the swing of the pendulum in one direction, but was to be a straining point only, over which the armature lever was to be strained so that the magnet could not overcome the power of the spring and make the armature lever swing away from the stop in the manner of a pendulum?

A. I doubt if he had any such meaning. I think he meant merely that the armature was suspended in the manner of a pendulum, but that he did not mean that it swung as a pendulum, its motion being regulated by means of a stop and of a spring strong enough to prevent any but excessively minute vibrations.

162 x-Int. If those ideas which you have expressed as the intention of the writer of this article are not contained in the two and a half lines which I have quoted, are they contained anywhere else? If so, point them out?

A. I think those ideas which I have expressed are the obvious meaning of the two and a half lines referred to in the question, taken in connection with the figure B, to which they directly apply, and in connection also with this quotation: "Thus vibrations cor-
" responding to the vibrations of the membrane in the transmitting
" apparatus are induced in the armature of the magnet."

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163 x-Int. Will you show the Court what there is in the drawing to suggest to any one that the armature and its lever are not to vibrate to and fro in the manner of a pendulum, swinging upon the fine black line representing the support at each make and break of the circuit, the magnet pulling the armature in one direction and the spring in the opposite direction when the circuit is broken, but that that fine black line represents a fixed point against which the lever is to be strained sidewise, and the stop / represents straining point against which the lever is to be constantly strained, and not an adjustable stop to arrest the backward swing of the armature when the magnet is discharged. Point out the peculiarities which an electrician would see in that drawing to indicate that that armature is not a swinging armature as it is in relays and sounders generally?

A. The drawing itself, figure B, without any description or statement of its operation, might not give to an electrician any definite idea of the way in which it was to be used; but an electrician, having the description before him; and the statement of the effects to be produced, even if limited to the quotations already made, would see that if the stop / was intended to limit the free swing of the armature, it would have been placed near the armature end of the lever and not near the axis of suspension, allowing a sufficient length of the elastic lever plate to vibrate beneath it, in correspondence to the vibration of the membrane in the transmitting apparatus.

164 x-Int. Then you mean to swear, do you, that that drawing by itself would not suggest to an electrician a definite idea that the armature was a swinging armature in the manner of a pendulum, and that when the stop usual in such instruments is nearer to the suspension axis than to the armature, in the ratio of seven to eleven; which is the case in that drawing; an electrician would infer that a swinging armature was not intended in that instrument?

A. My answer was, that the drawing itself, taken alone, might not give to an electrician any definite idea of the way in which it was to be used. I did not say that it would not. I think the inference which I have stated in a previous answer, would be made by an electrician under the conditions stated.

165 x-Int. Wont you answer this question: Suppose that drawing were to be shown to you, as an electrician, without any further instructions as to its objects or uses, wouldn't you infer that that was a swinging armature in the manner of a pendulum? And if you deny that, point out to the Court what peculiarity of that

drawing would lead you to believe that the armature was not to be visibly moved, but was to be strained up to the stop?

A. If I should have seen this drawing before the time of the telephone I should have been puzzled by the broad lever plate, by the sounding box under it, and by the position of the stop *l*. I think after the time of the telephone that I should have got some idea of its use, in the manner which I have stated, though I am not certain that I should have done so.

166 x-Int. Before 1876, if you had seen that drawing, wouldn't you have inferred that the armature was a swinging one, after the manner of a pendulum and of the relays in common use at that time?

A. Possibly, I should.

167 x-Int. Don't you believe you would?

A. I think it probable that I might; but I do not think it certain.

168 x-Int. Considered as an instrument in which the circuit is to be made and broken at each air-wave, and with the effect of transmitting pitch, and not intensity as that word is used in the art, is not that receiver with a swinging armature after the manner of a pendulum an entirely effective instrument?

A. Before answering this question I would like to qualify my answer to the two previous questions. Before 1876, I am confident, on further reflection, that I should have inferred that the instrument shown in the drawing had an armature motion similar to the relays then in use.

In answer to cross-interrogatory 168 I should say yes, for common telegraphic purposes, but not for the purposes and uses described in the Reis-Legat article.

Adjourned till July 1, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

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29 WALL STREET, NEW YORK,
JULY 1, 1884, 11 A. M.

Adjourned, by consent of counsel, till July 2, 1884, 11 A. M.

J. A. WELCH,
Special Examiner.

29 WALL STREET, NEW YORK,
JULY 2, 1884, 11 A. M.

Met pursuant to adjournment.

Present—MR. DICKERSON, for complainants: MR. PECKHAM, for defendants.

CROSS-EXAMINATION OF MR. CHANNING RESUMED BY MR. DICKERSON.

168 x-Int. The witness further answers this question as follows:

A. The instrument will be effective in the sense of being operative, but not necessarily in the sense of being usefully operative.

169 x-Int. Wouldn't it be operative to reproduce the exact number of the original vibrations of the air-waves which at each condensation opened the circuit and at each rarefaction closed it?

A. It might do that, but it could not produce the effects described in the following extract from the article, namely: "In consequence "of the imperfection of the apparatus at this time, the minor differ- "ences of the original vibration are distinguishable with more diffi- "culty—that is, the vowel sounds appear more or less indistinct,— "inasmuch as each sound depends not merely upon the number of "vibrations of the medium, but also upon its condensation and "rarefaction. This also explains why chords and melodies were "transmitted with marvelous accuracy in the practical experiments "hitherto made, while single words in reading, speaking, etc., were "less distinctly recognizable, although even in these the inflections "of the voice, as in interrogation, exclamation, surprise, calling, etc., "were clearly reproduced."

170 x-Int. Won't you answer the question; which is, whether it would not produce those effects?

A. I think it would depend entirely on the rapidity of the original vibration of the air-waves. While acting as a single armature, it could reproduce tones, of a low pitch, but not musical sounds of a high pitch, or articulate sounds.

171 x-Int. Fix the number of vibrations at which it would not operate, as you understand it?

A. It would be the merest guess-work, how an instrument, which seems to me to be clearly made for the transmission of delicate and rapid vibrations, can be made to work in a manner for which it is not mechanically adapted.

172 x-Int, It is not the merest guess-work, however, is it, that if

that instrument operated in the manner of a pendulum, it certainly would not transmit intensity?

A. I do not know why it should not.

173 x-Int. Then, if it would transmit intensity, as well as pitch, when operating as a pendulum, it would be capable of transmitting articulate speech, would it not?

A. Not unless it were capable of sufficiently rapid vibration. From my analysis of resultant harmonic curves, and from my observation of Mr. McDonough's rheotome transmitter, I believe that articulate speech may be transmitted by sounds varying simply in pitch and intensity. I do not intend to exclude other methods of transmission.

174 x-Int. But, in order to transmit articulate speech, the instrument must be capable of transmitting intensity; must it not? Or, do you think that articulate speech can be transmitted by pitch alone?

A. I think that articulate speech requires at least pitch and intensity. In McDonough's rheotome transmitter, I think, the effect of varying intensity is obtained by varying the length of the make and break of the circuit wheel, producing greater or less intensity of magnetism. It is only in this sense, which makes pitch really include intensity, that I should say that articulate sound could be produced by pitch. I would note, however, this exception: Helmholtz makes the vowel sound of the German u, or English oo, to consist of a single pure tone of pitch, b flat, I believe.

175 x-Int. But you wouldn't call an instrument that would sound b flat a talking machine, would you?

A. Not exactly; but Helmholtz offers the tuning fork, which produces that tone, as his apparatus for reproducing that vowel sound.

176 x-Int. And you wouldn't call a circuit breaker that can be made to say "hello," or a doll that when squeezed will say "papa," a talking machine, would you, any more than you would call a tuning fork a talking machine because it could pronounce a vowel?

A. I think I should, but I shouldn't confound under the same designation an electric rheotome transmitter with the talking doll.

177 x-Int. If this Reis transmitter was constructed to operate with a strained-up armature, as you have sworn, it would produce its effect, at whatever angle it happened to stand, wouldn't it, there being no pendulum to take care of in the operation; just as the

Bell receiver with a constrained armature sounds equally well, at whatever angle it stands?

A. Regarded as an acoustic apparatus, with a vertical support resting on the sounding box, and with a long, broad, light lever, more or less influenced by gravity, I think it would operate best in its normal position, but that it would operate fairly well in any other position.

178 x-Int. What has the long broad lever to do with the operation at all, when the armature is constrained so that it cannot yield to the attraction of the magnet visibly, and the invisible vibration is below the stop /?

A. The vibration extends through the whole of the armature lever. It has two points of rigid support at the centre, with both ends free to vibrate; simply reversing the conditions of the diaphragm in the modern telephone, which is held either by two rigid points of attachment at the periphery, as in the patent of A. Graham Bell of January, 1877, or is held rigidly throughout the whole extent of the periphery, allowing the centre to vibrate.

179 x-Int. But wouldn't it operate just as well, whether that vibrator were exactly perpendicular or slightly inclined?

A. I do not know, but I should judge not quite as well.

180 x-Int. Explain the position which that armature should be screwed up to in order to work properly and why there is any such position required, when the whole thing is to be strained up so that it cannot move visibly?

A. I had reference chiefly to the vertical position of the support in reference to the sounding-board. With that exception, I think, it would operate equally well in any position, supposing the weight of the lever plate and armature above and below the two points of central support to be equal.

181 x-Int. Explain to the Court why the support should have to be exactly perpendicular, in order that the sounding board might work to the best advantage, if you know any such reason as that?

A. If it was tipped to one side it would strain unequally the thin cover of the sounding box and thereby impair its action.

182 x-Int. And you think, do you, that the leveling screws, with which that apparatus is provided for adjusting the perpendicular, were put there to prevent the thin top of the sounding box being strained by the apparatus being out of perpendicular, and not for the purpose of meeting the requirements of an armature mounted after the manner of a pendulum and delicately adjusted?

A. I think they were put there for the purpose of support with some reference to horizontal position, as is very commonly the case with electro-magnetic apparatus requiring no precise adjustment of level. Although in the description the armature lever is ordered to be made as long as possible, I see in figure B that the lower part of the lever carrying the armature must be heavier than the upper. In that case, the adjusting screws on which it stands might supplement, though far less powerfully, the adjusting screw *o* in its control over the armature and lever.

183 x-Int. By which you mean, as I understand it, that those leveling screws are to assist the retractile spring and adjusting screw, in controlling the armature, so that when it is strained up in position, the magnet shall not be able to overcome the retractile spring and drag the armature towards itself; which assistance is due to the difference between the ordinary level found in tables on which this instrument may be supposed to stand, and the more accurate level which these adjusting screws would enable the operator to obtain or to destroy?

A. I do not think that is my meaning. Their action would be exceedingly slight and almost inappreciable, in my opinion, in either of the supposed uses of the instrument.

184 x-Int. In the apparatus you used was there a sounding box, and was the rear end of the magnet attached as shown in the drawing?

A. It was, to the best of my belief.

185 x-Int. Don't you know that in an apparatus like that, without any regard to the end of the armature lever projecting up into the air, the action of the magnet itself, when worked by a microphone transmitter, will cause that apparatus to sound in unison with the varying undulations of electricity along the wire?

A. If reference is made to the position of the magnet on the sounding box, I should say that it was placed where it would produce the least possible effect, though undoubtedly it communicates some vibrations to the sounding box.

186 x-Int. Question repeated.

A. Yes, more or less.

187 x-Int. Don't you know that it would do so more, and not less, and that, under those circumstances, it can transmit speech?

A. I think with this apparatus it would do so less and not more, and that, of course, it contains the capacity of transmitting speech.

188 x-Int. Don't you know that, without regard to the projecting plate in the air, that apparatus, when worked with a microphone transmitter, will transmit speech?

A. The magnet without the armature will undoubtedly transmit speech, but in this apparatus I think inaudibly.

189 x-Int. Did you ever try it with the upper end of the plate left off, above the point of suspension?

A. I never did. I only tried it as represented in Figure B.

190 x-Int. Did you try the entire apparatus, or only the receiver described in that article?

A. I do not remember whether I tried the entire apparatus in my experiments with Professor Brackett; but I tried the Legat transmitter and receiver successfully together at the house of Professor Morton, at Hoboken. That is, to the extent of hearing several words through them.

191 x-Int. When you were trying those experiments with Professor Brackett, on the faith of which you have sworn that this article described a receiver not operating in the manner of a pendulum, but operating in the manner of the Bell receiver, why didn't you try the only combination which that article describes as producing its results?

A. I do not remember whether I tried that precise combination or not?

192 x-Int. But how long after January, 1878, did you entertain the opinion that Professor Bell's discovery was unique and complete, the greatest, perhaps, of modern science applied to the arts; when did you change that opinion, and what were the circumstances that led you to change it? Was that change due to anything personal to yourself in connection with Professor Bell or the Bell Company, or to some other cause; and if so, what?

A. On or about the 18th of January, 1878, I called at the office of the Western Union Telegraph Company in search of Mr. Edison, who had recently brought out his phonograph. Going to the room of Mr. George B. Prescott, the author of the well known works on electricity and the telephone, I was introduced by him to Mr. Elisha Gray. From Mr. Gray I heard the story of the presentation of his caveat on the same day with Professor Bell's application for his patent of March, 1876. I was also introduced at the same time to Professor Dolbear, but the long conversation that ensued was chiefly with Mr. Prescott and Mr. Gray. From them I received statements of fact which, if credited, deprived Mr. Bell of his title

to the invention of the speaking telephone. Mr. Prescott had heard that I had made the first hand telephone, and asked me to allow the Western Union Telegraph Company to patent it, bearing all expenses, and to pay me for it. I declined, stating to him that I had promised Mr. Bell to hand over to him the results of all my telephone experiments. Mr. Prescott's reply was very nearly this: If I can prove to you that Professor Bell has stolen the whole from Mr. Gray and Professor Dolbear, won't you decide differently? I gave no answer, but the conversation made so great an impression that I communicated almost immediately with Mr. Chauncey Smith, Mr. Bell's attorney, expressing my anxiety to be entirely just both to Professor Bell and to Mr. Gray, but, if I remember right, withdrawing an offer which, I think, I had made to Mr. Smith to patent the hand telephone, as a friendly act to Mr. Bell, until I should be satisfied to whom the invention was due.

Shortly after this time Professor Bell's English lecture appeared, in which he appropriated certain things as his own which I supposed originated with myself. On this point again I consulted Mr. Chauncey Smith, and wrote to Professor Bell without receiving any direct answer.

This is the extent of any personal difference between myself and Professor Bell. It has had no influence upon my opinion in the controversy between Mr. Bell and Mr. Gray, or with Mr. Dolbear, or Edison, except in so far as it impressed me with Professor Bell's disposition to exaggerate his own claims to invention. I did not become aware until afterwards of the complete anticipation by Reis of the discovery of the speaking telephone.

193 x-Int. Won't you tell the Court at what date you changed the opinion which you entertained in January, 1878, that Professor Bell's invention was the greatest, perhaps, of modern science applied to the arts? Was it at that conversation with Prescott, or was it at some subsequent date?

A. My opinion as to the greatness of the discovery never changed. My feeling with regard to Professor Bell's part in the discovery changed gradually as I learned the facts of previous discovery and invention by others. I cannot fix any precise date.

194 x-Int. Who are the others referred to by you who made that greatest discovery before Professor Bell did?

A. Elisha Gray, Reis, and, at a later date, several others.

Counsel for the complainants calls upon the counsel for the defendants to produce and have identified all the various

apparatus which this witness has testified to be talking telephones, and with which he says he has experimented, in order that they may be tested and compared with the original drawings and descriptions.

He also calls upon the counsel for the defendants to have those instruments talked with, at any time or place convenient for him, in the presence of experts, in order that a record may be made of what the defendants' experts may be able to produce in the way of conversation with these different apparatuses, as was done in the case of the American Bell Telephone Company vs. Dolbear, who set up the Reis apparatus as a defense and had it sworn to as a practical talking apparatus.

Adjourned till July 3, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

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29 WALL STREET, NEW YORK,
July 3d, 1884, 11 A. M.

Adjourned, by consent of counsel, till July 9, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

JULY 9th, 1884.

EXAMINATION OF WM. F. CHANNING, RESUMED. RE-DIRECT BY MR. PECKHAM.

195 Re-d. Int. Referring to your answers to cross-interrogatories 44 and 46, I would ask whether in your answer to Interrogatory 31, your attention was drawn or given to any other point than the identity of the mode of operation of the instrument described in the Bell Patent 174,465 with the mode of operation of Exhibit Holcomb Telephone, so that words descriptive of the mode of operation of the one would be equally descriptive of the mode of operation of the other?

A. It was not.

196 Re-d. Int. You said in answer to the 63d cross-interrogatory, that the theory contained in the Bell Patent 174,465 does not describe his telephone. Please state in what respect that theory so

contained fails to describe that telephone as referred to in your said answer?

A. In my answer to the 63d cross-interrogatory I referred to Prof. Bell's first patent as not describing the speaking telephone, and my reference is not to the theory contained in the patent, but to the patent itself.

197 Re-d. Int. If you say that Bell's first patent does not describe the speaking telephone, what do you mean to be understood as saying that it does describe?

A. An improved form of multiple telegraph.

198 Re-d. Int. Referring to your answers to cross-interrogatorties 84 and 85, please state whether in any of the Exhibits transmitter of Van der Weyde you find any method of adjustment other than those referred to in your answer to the 84th Interrogatory and any diaphragm, properly so called, in any Exhibit Van der Weyde Receiver? And if so, please point out and describe the same, both as to transmitters and receivers?

A. I find in Exhibit Van de Weyde Transmitter No. 1, a screw adjustment by which one of the electrodes may be brought into closer contact with the other, or the pressure between the two diminished. It seems to be a thoroughly effective adjustment. Exhibit Van der Weyde Transmitter No. 2, has a portion of a similar adjusting apparatus, a part having been apparently lost.

Exhibit Reproduced Van der Weyde Transmitter No. 2 contains this screw adjusting apparatus in its perfect form.

Exhibit Van der Weyde Receiver No. 1 has a brass diaphragm with a piece of iron attached to the center.

Exhibit Van der Weyde Receiver No. 3 has a diaphragm of tinned iron plate.

199 Re-d. Int. Please state the functions of the adjustments of the transmitters to which you have referred?

A. The function is that of any microphone transmitter. When delicately adjusted and with a moderate sound, the diaphragm will copy approximately the air vibrations, which reach it through the speaking tube. With loose adjustment, or with loud sounds, the contact between the electrodes will be occasionally, perhaps regularly, broken at each vibration. In these respects it would act similarly to the Blake, Berliner, or other well known microphone transmitters.

200 Re-d. Int. Referring to your answers to the 93d and 106th cross-interrogotaries, can you state, or can it be told, in the present

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state of knowledge, whether the instrument Defendants' Exhibit Transmitter acts by means of variation of pressure or by means of variation of points of contact, as made and broken by the vibration of the cork diaphragm to which the carbon is attached?

A. As I have already said, I think variation of pressure involves always a making and breaking of points of contact, though also affecting resistance of the current in other ways. With this definition I should not wish to exclude variation of pressure from any form of microphone transmission. In the loose contact transmitters, like the Exhibit Defendants' Transmitter, the probability is that the resultant sound vibrations are copied, so far at least as articulation is concerned, by the variation in a great number of makes and breaks.

201 Re-d. Int. I now hand you an instrument and ask you whether the same is substantially in accord with the drawing of the receiver in the Reis-Legat Article described, and if not, in what respect it differs; calling your attention, of course, to the apparent greater length of the armature lever?

A. It is essentially the same instrument, with some minor differences, as for instance the addition of clamp screws to the adjusting screws, and stationary feet in place of screw-adjusting feet.

> The instrument mentioned in the above question offered in evidence by defendants and marked Exhibit Reis-Legat Receiver, July 9, 1884, J. A. W., Special Examiner."

(Witness continues.)

I observe that the plate lever is not of uniform thickness, as represented in Figure B.

202 Re-d. Int. I now hand you another instrument, and ask if the same is what is commonly known as a Morse sounder, and known as such in the years 1860 to 1865; and if it differs from the instruments then known as Morse sounders, point out in what respects?

A. I cannot compare it from memory with the Morse sounders of the date referred to. It contains the essentials of all the Morse sounders which I remember.

> The instrument last referred to offered in evidence by the defendants, and marked "Defendants' Exhibit Morse Sounder, July 9, 1884, J. A. W., Sp. Exr."

203 Re-d, Int, With those instruments before you, please point

out in what respect the Reis-Legat receiver essentially differs from the sounder?

A. One prominent difference is the double stop which is a prominent feature of the sounder as an acoustic instrument. The stop which prevents the armature from coming in contact with the magnet, gives also the direct blow indicating the completion of the circuit. This stop is wanting in the Reis-Legat receiver. The armature lever of the sounder is short, thick and inelastic. When the battery circuit is broken and the magnet demagnetized, the spring carries the armature lever against the second stop, making with it a sharp click. The metallic supports are so grouped together as to give the sharpest sound of concussion at both the to and fro movement of the armature. There are two sounds produced therefore, where one would be produced by the Reis-Legat receiver.

In the Reis-Legat receiver the absence of the direct stop would bring the armature in contact with the magnet if it was free to swing: and, once in contact with the magnet, it would be held there, even after the current was broken, against any retractile force of the spring, which could probably be used on the supposition of a swinging motion of the armature. If any such swinging action had been intended, a direct stop would have been used, not only to limit the motion of the armature, but to receive the concussion supposed to be the source of sound. The length, breadth and thinness of the armature lever, and also its elasticity, show the difference of its function from the armature lever of the sounder. It is adapted to communicate delicate sound vibrations to the air, while the two stops and anvils of the sounder are adapted to produce the sharp double clicks of the Morse Code.

In the Figure B, the reverse stop *l*, from its position in the perspective drawing, is showing in my opinion to be in contact with the armature lever *i*, the natural adjustment of the system composed of the support *k*, armature lever *i*, the screw *o* and stop *l*, taken in connection with the sounding-board, and considered as an acoustic apparatus for the reproduction of delicate sounds.

204 Re-d. Int. In the several articles to which you have referred as describing the different forms of the Reis telephone, I notice references are made to the transmission of words and speech. Please state how you understand the operation of the Reis telephone in any of the forms, when producing the result of transmitting words or speech?

A. As I have already stated, in the bored block transmitter and

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the cubical box transmitter the condensation which carries the diaphragm forward necessarily moves the electrodes over each other, making changes of contact and probable interruptions of contact within the limits of a single vibration.

If the adjustment is delicate or the sounds not too loud, there is no separation of the electrodes beyond perhaps the film of air, or the arc, which may be always latent conductors between the electrodes, or no separation of the electrodes during the whole period of rarefaction. I am disposed to believe that during the return of the diaphragm, in microphone transmission, and during the period of rarefaction of the air, not only in the Reis instruments, but in the Blake and in all other forms, there are a large number of minute makes and breaks, sufficient to release the diaphragm at the receiving end of the line from the attraction of its magnet, without producing the effect, as regards sound, of a continuous break. The Reis transmitters are at any rate subject to the same law, in this respect, as the Blake transmitter. In the Reis-Legat transmitter I have spoken of the electrodes as separated during the condensation, or first motion of the diaphragm. On account of the adjustable spring which forms one of the electrodes, it is not necessary that the circuit should always be broken, and I would wish to that extent to qualify my previous answer. There may be a play between the lever and the spring, both during the condensation and rarefaction, which would subject the current to variation. With the five cells of battery and the electro-magnet shown in the Reis-Legat instruments, talking through the arc would be quite possible.

205 Re-d. Int. In your cross-examination I have understood you to say, that the resultant curves of Blake and Mayer, which are shown on the diagrams made a part of the testimony of Professor Cross, are characterized by abrupt and angular changes.

That being so, please state what would be the character of the electric current produced by the vibrations of a diaphragm in front of the poles of a magnet, as in magneto transmission, when actuated by air waves which would be properly graphically represented by such curves?

A. The diagrams of Professor Blake show the motion of the diaphragm of the telephone during articulate speech. In magneto transmission the motion of the diaphragm is the sole originator of the articulating electric current.

Professor Blake's curves show a few characteristic violent changes in the motion of the diaphragm corresponding to the dif-

ferent articulate sounds. These violent changes appear to be almost exclusively confined to the forward motion of the diaphragm during condensation, or to the neighborhood of the point of greatest condensation. The effect of these changes, which appear to be the exclusive elements of articulation, must be to induce abrupt, sudden and violent electric pulsations, going to the extent of sudden and absolute reversals of the induced electric current. Similar arrests and reversals of motion are shown in Professor Mayer's resultant curves. The induced electric currents of this character are absolutely excluded from Professor Bell's definition of undulatory currents in his patent No. 174,465. He there states, in distinguishing between undulatory and pulsatory currents, "That electrical pulsa- "tions are caused by sudden or instantaneous changes of intensity, "and that electrical undulations result from gradual changes of in- "tensity exactly analogous to the changes in the density of air oc- "casioned by simple pendulous vibrations." The changes of motion of the diaphragm shown in Blake's curves are "sudden and instantaneous," and must induce sudden and instantaneous changes of electric intensity in a telephone circuit actuated by such diaphragm, and such changes are by the definition of the patent, the electric pulsations which it disclaims.

Immediately following the quotation already made, the patent says, "The electrical movement, like the aerial motion, can be rep- "resented by a sinusoidal curve or by the resultant of several sinu- "soidal curves." This may be perfectly true, but it does not make such electrical movement any the less pulsatory. As an explicit answer to the question, therefore, I believe that a diaphragm in articulating magneto transmission, induces electric "pulsations and not undulations."

206 Re-d. Int. Please state the precise character of the difference or distinction between electric undulations and electric pulsations, and between pulsations and makes and breaks in the current?

A. The distinction between pulsations and undulations is one, I suppose, originally made in Professor Bell's patent 174,465. He defines his pulsatory current as one produced by alternately increasing and diminishing the intensity of the current without actually breaking the circuit, and these changes of intensity he supposes to be sudden or instantaneous. This differs from a make-and-break current mainly by the fact that a portion of the current remains upon the line.

In speaking, in a former answer, of shocks perceived by the tongue during speech through the defendants' instruments, in which my body was made part of the circuit, I referred to them as indications of interruption of the circuit, or as, in my opinion, so caused. The distinction between a pulsatory current and an interrupted or make-and-break current is so slight that similar induced shocks may be obtained from a pulsatory current; as, for instance, when the primary current of an induction coil is suddenly shunted or short-circuited.

207 Re-d. Int. Referring to the Bell patent No. 174,465, what combination of sounds is illustrated or intended to be illustrated by Figure 4, and what kind of sounds is Figure 7 adapted to transmit?

A. Figure 4 represents the combination of two fundamental musical notes of relative pitch, four to five. The resultant curves *a b*, Figure 4, shows some eccentricity, but does not violate the conditions of the undulatory current as described by Professor Bell. The object of Figure 4 is shown in the patent to be the transmission upon a telegraphic circuit of electric vibrations of different pitch at the same time. These fundamental notes are combined, as described in the patent, in order to be analyzed and separated again at the receiving instrument, so as to distinguish one telegraphic message from another at the receiving station. The patent shows that the object and purpose of the undulatory current is to transmit thus a few fundamental musical notes, to be separated afterwards, and not to transmit over-tones and the vast range and variety of vibrations which characterize articulate sounds.

This extreme range of vibration cannot be transmitted by the undulatory current, as defined by Professor Bell, the electric transmission passing necessarily into the pulsatory character, as shown by the form of the resultant curves.

Another radical distinction between the transmission of fundamental sounds for the purpose of multiple telegraphy and the transmission of sound for the purpose of articulation is, that in the latter case the compositeness of the sound is one of its chief and essential characteristics, while in the former case the few fundamental notes transmitted are transmitted for the purpose of being separated again.

In speaking of Figure 7, in a previous answer, I have said that it was not adapted to transmit sounds possessing quality. I have also stated in my answer to the 4th interrogatory, that there was no indication anywhere in this patent that its purpose is the transmis-

sion of sounds possessing quality. I should wish to qualify these statements so far as the transmission of a few fundamental notes is concerned, as indicated in Figure 4. Beyond this I see no indications of the transmission of sounds possessing any of the distinctive features of articulation.

Adjourned till July 10th, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

JULY 10th, 1884, 11 A. M.

EXAMINATION OF WM. F. CHANNING RESUMED.

Present—same counsel as yesterday.

RE-CROSS EXAMINATION BY MR. DICKERSON:

208 Re-x-Int. You say that Bell's first patent describes an improved form of multiple telegraphy, and does not describe a speaking telephone. Will you explain to the Court how that patent instructs a number of persons desiring to transmit a number of telegraph signals to a number of persons receiving the same, to operate with Figure 7 so as to convert it into a multiple telegraph?

Place the senders where you think they are designed to be according to the instructions of that patent, and the receivers, having the two ends of Figure 7 respectively, and describe the operation as you understand the patent directs it to be done. Make this statement in your own language, without quoting from the patent, assuming Figure 7 to be the instrument employed?

A. The patent describes three sets of instruments, Figure 5, Figure 6 and Figure 7. The instruments in Figure 6 are the same as in Figure 5, but grouped in larger number and classified according to pitch. The instrument in Figure 7 differs from these in the capacity of its diaphragm to transmit a larger number of sounds of various pitch. The patent says that when the armature of any one of the instruments in Figure 6 is set in vibration, other instruments in unison with it on the same circuit will respond, and continue sounding as long as the vibration of the armature continues, and become silent when its motion ceases. Also that the duration of the sound may be used to indicate the dot and dash of the Morse code, and that when two or more of these instruments are set in

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vibration at the same time the corresponding receiving instruments vibrate, and those only. The patent then goes on to state that by these instruments two or more telegraphic messages may be sent over the same circuit without interfering with each other.

Referring to a similar instrument in Figure 5, the patent states that it may be set in vibration by wind, and that another mode is shown in Figure 7, which may be set in vibration by the voice or a musical instrument, and that a similar sound uttered into one of the cones of Figure 7 will be heard to proceed from the other cone.

The only use which I see specified for all these instruments is, as above, the indication of the dot and dash of the Morse alphabet in sounds of different pitch, which can be separately distinguished afterwards, and which may therefore constitute two or more telegraphic messages sent simultaneously over a single line; but explicit directions for this use of Figure 7 are given by Professor Bell in his subsequent patent, No. 186,787.

209 Re-x Int. Won't you answer the question? It is this: Given figure 7 and a number of persons at one end of it and an equal number at the other, and assuming it to be true, as you swear you think it is, that figure 7 was not designed as a telephone but as a multiple telegraph; now explain to the Court how that number of persons are to use figure 7 in order to transmit a number of separate telegraph signals to their correspondents at the other end, as you understand the object, design and construction of figure 7, as the same is described in the patent No. 174,465?

A. I understand that two or more persons are to make musical sounds, each differing in pitch, in any convenient way, in the neighborhood of the open mouth of the cone A, and to let the duration of the sound signify the dot or dash of the Morse alphabet. The operators who receive the messages will fix their attention as directed by Professor Bell in patent No. 186,787, each upon a message of particular pitch. To make this more easy, the operator will listen to his telephone through a resonator, which selects sounds of a certain pitch, approximately excluding others. In this way multiple messages can be sent through figure 7, in my opinion, supposing it to be sufficiently well constructed and adjusted.

211 Re-x Int. As you know, I didn't ask you anything about patent No. 186,787, nor about the multiple system there described and patented in the year 1877.

I asked you about the instructions found in the patent No. 174,465 of 1876; and I now repeat the question in another form, and

request an answer to it without dragging into it anything about Professor Bell's subsequent inventions. Do you now mean to swear that in your judgment the specification of March 7th, 1876, instructed the reader to use figure 7, not as a telephone in which one person uttered his voice in the cone A, and another person with the cone L, placed to his ear heard similar sounds to those uttered into A, but that it instructed the user that a number of persons should stand in the neighborhood of A, each making a musical sound of a certain pitch, differing each from the other, and that a number of other persons should stand around L, each with a resonator in his ear and each endeavoring to select the musical sound which his resonator was adapted to receive, the apparatus constituting a multiple telegraph of an improved kind?

A. I understood, and I understand cross-interrogatory 209 to ask how a number of persons are to use figure 7 in order to transmit a number of telegraph signals, and its only limitation to patent No. 174,465 is with reference to the construction and design of figure 7, as described in that patent, and I so answered it. I do not now mean to swear that the specification of March 7th, 1876, contains the subject matter of the present question, which it does not.

212 Re-x Int. In that specification it is said that "motion can be imparted to the armature in figure 7 by the human voice or by means of a musical instrument." Now, will you explain to the Court how a human voice or a musical instrument, when employed at cone A, could be used to convert that instrument into a multiple telegraph, as you understand the specification and the design of the instrument?

A. The specification of a musical instrument does not necessarily limit it to a single one. It is simply a description of the function of the instrument. I do not suppose that a musical instrument, unless of very complex construction, could send multiple messages through figure 7.

213 Re-x Int. Do you suppose the human voice could do it, or was designed to do it, according to the description of that patent? If so, explain how the person using his voice would convert that thing into a multiple telegraph, and how the number of persons receiving the number of messages at the other end would distinguish them?

A. The human voice, which may include the voice of several persons, could of course send multiple messages of different pitch, according to the Morse code, in the same manne veral musical

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instruments, and they would be received in the same manner as messages from such musical instruments. I do not suppose that it was specially designed to do it, though I have no means of knowing.

214 Re-x Int. You think, don't you, that when Professor Bell wrote the words, "by the human voice or by means of a musical instrument," he really meant to say, by a number of different voices at different pitches, or by means of a number of musical instruments?

A. I do not.

215 Re-x Int. Haven't you already said in substance that the design of figure 7, according to this patent, was a multiple telegraph; and if so, how do you suppose it was designed to work, unless by a number of human voices or by a number of musical instruments?

A. What I think I have said with regard to figure 7, is that its only specified use in connection with other instruments or the only use indicated for it, is that of multiple telegraphy, and I have stated my reasons for believing that figure 7 was intended to operate as a multiple telegraph by means of musical sounds of different pitch.

216 Re-x Int. Then it was designed, either that a number of human voices, or that a number of musical instruments, should be sounded in the neighborhood of A, was it not? And it was not designed that one person should utter his voice into A, and another person should hold the narrow end of L at his ear; as you understand the specification?

A. Anything that would produce musical sounds in the neighborhood of A differing in pitch, could be used for the purpose of transmitting multiple signals. A single musical instrument with several keys corresponding to different musical notes would transmit an equal number of distinct messages through A in figure 7, if the transmitting apparatus A should be suitably placed in the sounding box of the instrument. The keys in that case, would be operated like the common Morse keys. That seems to me to be the design, as regards the general method and purpose of figure 7, as indicated by the patent, taken in connection with the other instruments and the preceding description. This does not make it impossible for one person to make a noise in A and for another person within certain limits to hear it in L. One person could transmit musical sounds through A of course, where several could do so.

217 Re-x Int. What is the sounding-box of the instrument, within which the musical apparatus for transmitting several distinct messages is to be placed, as you understand the specification?

A. Supposing it to be a small reed organ with a few keys, the sounding box would be the case of the instrument containing the reeds. I give that as an illustration.

218 Re-x Int. Then, it seems to you to be the design of this patent, that A figure 7 should be provided with a small reed organ with a few keys and a sounding-box, on which a number of operators should perform. Now, tell the Court how the system is to be carried out at L, and how the various messages are to be translated into intelligence at that point, and describe it particularly so that it could be tested, if the Court should require it?

A. It does not so seem to me. At the receiving end the messages would be listened to, as already described, by an equal number of receiving operators who might use the common and well known method of analyzing or separating sounds of different pitch.

219 Re-x Int. Does it seem to you that this method of receiving the signals is the one designed and indicated by the patent; and, if so, explain what you understand the tapering end of the cone to signify, if a number of persons are to stand miscellaneously around it?

A. The patent contains no directions with regard to this method of receiving. The tapering end of the cone L would make it more convenient, perhaps, for one person to listen; but that I consider a very unessential detail in an instrument shown in such elementary form and so defective in parts as figure 7.

220 Re-x Int. Don't you believe the design of that construction was and is to converge the sound at the narrow end of that cone, which was to be inserted in the ear?

A. Undoubtedly it was one design of it.

221 Re-x Int. Hasn't it been a common practice since ever you first knew relays or sounders, to arm the ends of the electro-magnet with a thin sheet of brass, to prevent the armature from sticking, using only one stop, the brass taking the place of the other?

A. According to my recollection, that has been commonly done in very cheap forms of electro-magnetic apparatus, such as the vibrating armatures of medical induction coils. I do not think I remember it in instruments of precision. I see no indication of it in the instrument figured and described in the Reis-Legat Article, and it is not present in the Defendants' Exhibit Morse Sounder. I answer this entirely from memory.

222 Re-x Int. Isn't it essential to all electro-magnets having vibrat-

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ing or swinging armatures, either to have a brass cap on the magnet or a screw stop, to prevent the armature from sticking when it strikes the magnet?

A. It is not necessary in the case of a vibrating armature of the character which I find described in the Reis-Legat Article.

223 Re-x Int. Isn't it necessary in every case where the armature moves towards the magnet and is liable to strike it, that there should be either a brass cap or a stop?

A. It is necessary where an armature is liable to swing against the two poles of a U magnet unless it is desirable that it should stay there, that there should be a stop of some kind, to prevent its coming into actual magnetic contact.

224 Re-x Int. Assuming the Legat receiver to have a swinging armature, after the manner of a sounder or relays, and not to be screwed back so as to be incapable of moving visibly under the influence of a magnet; wouldn't you as an electrician, say, that as a matter of course the ends of the magnet covered in the drawing, as they are, by the armature were brass capped?

A. I should think that some method would be used to prevent the armature from coming in magnetic contact with the magnet.

225 Re-x Int. The only two methods in use known to you, are they not, are a stop and a brass cap, which are the equivalents of each other?

A. They are not exactly the only methods, but all the methods are substantially equivalent to each other.

226 Re-x Int. Does not the magneto telephone transmit sounds which are represented by the graphic curves of Blake and Mayer, to which you have referred?

A. It transmits sounds having the general form of the curves of Professor Blake which represents the diaphragm motion, and the same might be true with regard to the curves of Professor Mayer.

227 Re-x Int. And in that case are not the electrical undulations on the line wire substantially similar in form to the air vibrations whose curves are represented by Professor Blake in his diagrams, just as Bell's patent says they are; as you understand the subject; whether you call them undulations or pulsations or oscillations or vibrations?

A. I should prefer to say that there was a general similarity of form between the transmitting and transmitted curves.

[The witness, having completed his answer to the preced-

ing interrogatory, here requests to make the following explanations of his preceding testimony, as follows:]

I wish to correct my answer to cross interrogatory 208, in which I say that "explicit directions are given for this use of figure 7 by Professor Bell in his subsequent patent 186,787" (the use referred to being "the indication of the dot and dash of the Morse Alphabet"). The statement that explicit directions are there so given is incorrect, and I withdraw it.

I am also satisfied by reference to Patents No. 174,465 and No. 186,787, that the use of the figure 7 instrument is not limited to multiple telegraphy through *a single pair*, as implied by me to-day, the construction of those patents admitting the use of several pairs of those instruments by different operators for multiple telegraphy on the same circuit.

I wish to disclaim the title of Professor, by which I observe that I am occasionally designated in the record.

WM. F. CHANNING.

Subscribed and sworn to before me this 10th day of July, 1884.

J. A. WELCH,
Special Examiner.

Adjourned till July 11, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

29 WALL STREET, NEW YORK.
July 9th, 1884, 11 A. M.

Met pursuant to adjournment.
MR. DICKERSON present for complainants.
MR. PECKHAM for defendants.

EXAMINATION OF WILLIAM F. CHANNING SUSPENDED FOR THE PRESENT.

Deposition of MRS. ELLEN G. HOLCOMB, a witness called and sworn on the part of the defendants:

EXAMINED BY MR. PECKHAM:

1 Int. Mrs. Holcomb, what is your name, age and residence?
A. Ellen G. Holcomb; 52; Southampton, Mass.
2 Int. You were the wife of Alfred G. Holcomb?
A. Yes.
3 Int. You are not now?
A. No, sir.
4 Int. You were divorced from him some time since?
A. In 1881.
5 Int. About what time were you married to Mr. Holcomb?
A. In 1861, November.
6 Int. At or about the time of your marriage to Mr. Holcomb, do you remember about his being engaged in electrical experiments or work of any kind?
A. Yes; he was so, and had been for several years.
7 Int. Do you remember his constructing a machine for transmission of sound by electricity?
A. Yes, he did so; something that he called a speaking telegraph.
8 Int. Mrs. Holcomb, I show you the Defendants' Exhibit Holcomb Telephone, and I ask you if at that time you saw Mr. Holcomb at work at anything of this character, and, if you did, point out the features in this exhibit which you remember?
A. I recognize the instrument as being either the same or one precisely similar, recognize the magnets and the ear piece and the way it is placed on the base.
9 Int. What do you mean by the phrase "ear piece," what part of the instrument?
A. That tin piece that is placed on the diaphragm.

10 Int. Where did you see him use any instrument of that character, and when?

A. He had it at Northeast, Maryland. We used it there.

11 Int. What is Northeast?.

A. It is the name of a little village six miles from Elkton, in Maryland.

12 Int. What was he doing there?

A. He went down there with the purpose of buying a farm, and remained there for a short time.

13 Int. How long did you live there?

A. About two years.

14 Int. Where had you lived previously to going to Northeast.

A. In New York.

15 Int. Did you reside in Island City at any time?

A. We did, for some weeks previous to going to Northeast.

16 Int. Did you see this instrument of which you speak at any time in New York?

A. I did not see it in New York before going to Maryland. This was in 1861 that we were married, and I did not see it until we were in Maryland. He had his instrument at Cape May before we went to Maryland.

17 Int. What do you mean by Cape May?

A. The southern point of New Jersey.

18 Int. Is that any other place than Cape Island City?

A. Yes, it is called Cape May in a general way, and Cape Island City was the name of the place where we stayed.

19 Int. When you say Cape May and Cape Island City, do you mean the same place or different places?

A. The same place. We remained there for some weeks. We then went on to Elkton, and to Northeast. We had the instrument there and used it.

20 Int. When you used the instruments at Northeast, do you know whether he used a battery with them?

A. He did not.

21 Int. Did you ever talk through them?

A. Yes.

22 Int. Did you ever hear anything said through them?

A. Yes.

23 Int. How much could you hear, give us some idea of it?

A. I know we sent words back and forth. I do not recollect

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what we said, nor anything very particularly about it, more than that we got words through it.

24 Int. Mrs. Holcomb, won't you state the first you knew and observed of Mr. Holcomb's use of instruments of that character, or of any experiments made by him prior to getting that instrument to which you have referred, for the purpose of communicating sound by telegraph or electricity?

A. He spoke to me about it, told me of it. I knew what he had been doing.

25 Int. When was this?

A. In 1861.

26 Int. What did he tell you about it?

A. In a general way I understood it to be an apparatus to take the place of the ordinary working telegraph; that is, he could communicate through it by speaking.

27 Int. When you say you understood so, I want to ask you what you learned from him, not from anybody else?

A. I learned from what he said to me.

28 Int. Did he explain the operation of the instrument to you?

A. I cannot recollect just precisely how he explained it, but he must have explained it.

29 Int. You did not get any knowledge of it from any other person or other source?

A. No, I did not.

30 Int. After you came back from Maryland, where did you live?

A. In New York.

31 Int. Did you see him have it here in New York?

A. Yes, sir.

32 Int. Was anybody else present that you know of?

A. There were gentlemen that I knew of his trying it with, but I was not present when the gentlemen would call at the house, or he had the instrument at other places. He had places down town where he tried it. I know there was a Doctor Bradley that was very much interested, and they experimented together with it.

33 Int. What was Dr. Bradley's first name?

A. I do not know; he is deceased now.

34 Int. Mrs. Holcomb, was there any event by which you can fix the time at which you saw this instrument and had these explanations or statements from Mr. Holcomb with respect to it; if there is any such event state it.

A. We were married in 1861, and this thing had been completed before we were married. He had talked to me about it.

35 Int. Is there any other event by which you can fix the time?

A. We went to Northeast the year following our marriage, and there we used it.

36 Int. After you came back to New York, for some time was there any event which took place by which you can fix the time?

A. We separated in 1874.

37 Int. Can you fix and be sure of the date when you separated?

A. Oh, yes.

38 Int. And you have never lived together since?

A. No.

39 Int. Now, can you tell whether any of these matters of which you have spoken took place subsequent to the date of your separation?

A. What I have spoken of occurred before our separation; what I know of the instrument is what I learned before that time.

40 Int. Now I want to call your attention particularly to the part of that instrument which you have described as the ear piece, which I suppose may be called equally well the mouth piece—this tin part?

A. He had that in Northeast, Maryland.

41 Int. Did you ever see the instrument used without the tin piece and with the box separated from it?

A. We used it both ways.

42 Int. Did you ever see him use the instrument with a battery?

A. I don't recollect particularly; I should think I had; he was trying so many things, and had his batteries around so constantly, I should say he had tried it with a battery—certainly.

43 Int. That is a matter of inference and not of recollection?

A. I would not like to say positively; and still, I do feel very sure that he did use the battery with it.

CROSS-EXAMINATION BY MR. DICKERSON:

1 x-Int. How long did you remain in Cape May?

A. Well, it might have been three or four months—about that time.

2 x-Int. Where did you go from Cape May?

A. We went directly to Northeast, Maryland.

3 x-Int. You bought a farm there, didn't you?

A. Yes.

4 x-Int. How long did you live on that farm?

A. About two years.

5 x-Int. Then that was about 1864?

A. 1862.

6 x-Int. You went to Cape Island in 1861, didn't you?

A. Yes.

7 x-Int. You stayed there about four months; what time in 1861 did you leave there?

A. We left in the Spring of 1862, and went to Northeast.

8 x-Int. Then, you lived in Northeast two years?

A. Well, it may not be quite two years; it is about two years.

9 x-Int. Was it in 1864 when you left there?

A. I should say we remained eighteen months in Northeast; I think that was more precisely the time.

10 x-Int. Where did you go then?

A. Came to New York.

11 x-Int. Did you remain with your husband at that time?

A. Yes.

12 x-Int. Then you and he came to New York from there; did you?

A. Yes.

13 x-Int. How long did you live here?

A. Up to 1874.

14 x-Int. Didn't go anywhere else?

A. No.

15 x-Int. Came directly from Northeast to New York and remained here till 1874, when you separated?

A. Yes.

16 x-Int. Where did you live in New York?

A. We lived in Morrisania.

17 x-Int. What was your husband engaged in in New York?

A. He was superintendent of Frank Leslie's Art Department.

18 x-Int. How long did you live in Morrisania?

A. We were there three years; before that we lived in Eighty-ninth street for a time; moving about.

19 x-Int. Then, after you left Morrisania, where did you go to live?

A. I went to Southampton, Massachusetts.

20 x-Int. What year was that?

A. I went there in 1874; it might have been a little later; it might have been 1875; I was visiting amongst my friends for a while previous to going to Massachusetts.

21 x-Int. Then, from the time you came back to New York, in 1864, or thereabouts, you lived in Eighty-ninth street and in Morrisania all the time?

A. No; there were other places; we lived on Eighty-fifth street, and in several places, and moved about from year to year.

22 x-Int. Name where you lived?

A. In Eighty-fifth street, Eighty-ninth street, Morrisania.

23 x-Int. Is that all?

A. We boarded on Thirty-second street for a time; something less than a year, I should say.

24 x-Int. Anywhere else?

A. I don't recollect; I think that is all.

25 x-Int. You first saw that apparatus in Southeast?

A. Northeast.

26 x-Int. Was it exactly like that thing that is on the table now?

A. I should say it was, precisely; certainly, in its main features.

27 x-Int. Now, tell exactly how you used it, where it was put, and what was done with it?

A. We placed the diaphragm against the magnet. We used it several times. I recollect, particularly at one time, it was placed on a table in the house, one end; the other end was out in the garden.

28 x-Int. What was the other end?

A. It was the same instrument: Mr. Holcomb stood holding it and talked through it in that way.

29 x-Int. What do you mean by "the same instrument?"

A. Similar.

30 x-Int. He stood in the garden holding it?

A. Yes.

31 x-Int. How were they connected?

A. With wires.

32 x-Int. And you were in the house?

A. Yes.

33 x-Int. How long did operation last?

A. Well, the reason I recollect that particularly was because I became very much fatigued experimenting with him. He was very much interested in it, and trying it. I could notmeasure the time by minutes.

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34 x-Int. You could talk through it perfectly well, couldn't you?

A. Yes.

35 x-Int. Could you hear it as well as any other telephone?

A. Yes, we heard words distinctly.

36 x-Int. You could carry on a conversation couldn't you?

A. I recollect we heard words through it; I don't know how much of a sentence.

37 x-Int. You talked to each other didn't you, just as freely as you pleased?

A. Yes.

38 x-Int. Just as freely as you would use any other telephone?

A. Yes.

39 x-Int. Had you seen a telephone at that time?

A. No, I had not. I recollect his spending some little time in adjusting it and showing me how, and putting little wedges under it and getting it in the correct position.

40 x-Int. He got it in the correct position and he held one end in his hand and talked at the other?

A. Yes.

41 x-Int. Did you have his on a table?

A. He held it in his hand as he stood?

42 x-Int. But this was on a table?

A. Yes.

43 x-Int. When was the next time you tried it?

A. There in the same place.

44 x-Int. Did you try it frequently?

A. We did several times.

45 x-Int. What do you mean by several times? You were there for some months?

A. Possibly a half a dozen times.

46 x-Int. It was a perfectly good machine to talk through?

A. Yes.

47 x-Int. Then you moved from there to Northeast?

A. This was in Northeast. We came from Northeast to New York.

48 x-Int. What became of the instrument?

A. He brought it with him.

49 x-Int. What did you do with it then?

After that he frequently used it with his friends.

50 x-Int. Did he use it constantly?

A. With numerous perons.

51 x-Int. Where?

A. In our house, in Morrisiania, for one place; he had a laboratory there, and he used to have his friends come and show it to them.

52 x-Int. You talked just as well there as in Northeast?

A. Yes.

53 x-Int. A great many people talked through it, didn't they?

A. Quite a number, yes; he was in the habit of talking through it with his friends.

54 x-Int. He was talking through it with his friends for some years there?

A. Well, from time to time; there was a period when he was very much devoted to his business, and for a time he laid it aside.

55 x-Int. Didn't you talk through it to your friends?

A. No.

56 x-Int. Anybody could talk through it, couldn't they, like any other telephone?

A. Yes.

57 x-Int. The wires were always up, were they?

A. I could not say whether they were. He had a great many other instruments there. I never took any of my lady friends to use it.

58 x-Int. Up to 1874 he was continually talking through it to his friends?

A. Yes, sir; more or less.

59 x-Int. How many people do you suppose talked through it?

A. I could not say.

60 x-Int. A considerable number of people?

A. I could not say at all how many. I know that there were individuals that would come to the house that he would speak with about it?

61 x-Int. When you left him in 1874 the instrument was then in the same condition that it had been?

A. Yes.

62 x-Int. Where was it then?

A. In Morrisiania.

63 x-Int. There were a pair of them in that condition at that time?

A. Well, he had so many instruments there I could not say positively whether he had removed these at that time or not.

34 x-Int. You could talk through it perfectly well, couldn't you?

A. Yes.

35 x-Int. Could you hear it as well as any other telephone?

A. Yes, we heard words distinctly.

36 x-Int. You could carry on a conversation couldn't you?

A. I recollect we heard words through it; I don't know how much of a sentence.

37 x-Int. You talked to each other didn't you, just as freely as you pleased?

A. Yes.

38 x-Int. Just as freely as you would use any other telephone?

A. Yes.

39 x-Int. Had you seen a telephone at that time?

A. No, I had not. I recollect his spending some little time in adjusting it and showing me how, and putting little wedges under it and getting it in the correct position.

40 x-Int. He got it in the correct position and he held one end in his hand and talked at the other?

A. Yes.

41 x-Int. Did you have his on a table?

A. He held it in his hand as he stood?

42 x-Int. But this was on a table?

A. Yes.

43 x-Int. When was the next time you tried it?

A. There in the same place.

44 x-Int. Did you try it frequently?

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A. Possibly a half a dozen times.

46 x-Int. It was a perfectly good machine to talk through?

A. Yes.

47 x-Int. Then you moved from there to Northeast?

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49 x-Int. What did you do with it then?

After that he frequently used it with his friends.

50 x-Int. Did he use it constantly?

A. With numerous perons.

51 x-Int. Where?

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54 x-Int. He was talking through it with his friends for some years there?

A. Well, from time to time; there was a period when he was very much devoted to his business, and for a time he laid it aside.

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A. Yes, sir; more or less.

59 x-Int. How many people do you suppose talked through it?

A. I could not say.

60 x-Int. A considerable number of people?

A. I could not say at all how many. I know that there were individuals that would come to the house that he would speak with about it?

61 x-Int. When you left him in 1874 the instrument was then in the same condition that it had been?

A. Yes.

62 x-Int. Where was it then?

A. In Morrisiania.

63 x-Int. There were a pair of them in that condition at that time?

A. Well, he had so many instruments there I could not say positively whether he had removed these at that time or not.

64 x-Int. What do you mean by removing them?

A. Perhaps taken them down to his office or some other place.

65 x-Int. Where was his office?

A. He was at Mr. Leslie's.

66 x-Int. Did he have any other place of business than that?

A. At different times he had different rooms, and I could not always say just where his office was; whether he had any other room than Mr. Leslie's place.

67 x-Int. He had only this instrument, as far as you know. He did not have more down town to your knowledge?

A. No.

68 x-Int. This Dr. Bradley that you speak of was one of the people that used to come there, was he?

A. Yes; I have known of his using the instrument with Doctor Bradley.

69 x-Int. That was about 1873 or 1874, was it?

A. I could not say the date, but it certainly was between 1861 and 1874.

70 x-Int. It was after you came back to New York. You came back to New York in 1864. Then it was between 1864 and 1874 that he was using it with Doctor Bradley?

A. I should say so; yes.

71 x-Int. No doubt about that, is there?

A. No.

72 x-Int. How many times did you see Doctor Bradley there; frequently?

A. I was not in the habit of seeing the gentlemen that called on Mr. Holcomb; very rarely. If a gentleman came I was not present.

73 x-Int. How did you know Doctor Bradley was there?

A. I used to hear Mr. Holcomb speak of him very frequently.

74 x-Int. Very frequently talk of him as having been there?

A. Yes; and Mr. Holcomb had been at his place, wherever that was.

75 x-Int. Up to the time you left there the instrument had never been broken up or lost; up to 1874?

A. I cannot say. I know there was a period of time, it was between our returning from Northeast and 1874, there was a time when Mr. Holcomb was very much confined to his business, and he neglected his electrical experiments in a great measure, and just what condition his instrument was in at that time I could not say, or just where his instrument was. He had a great room in his house

he called his laboratory, and he had a great many instruments there and all his electrical apparatus. I could not say precisely what he had or in what condition his apparatus was.

76 x-Int. When did you see this instrument now for the first time since 1874?

A. I saw it the other day. Mr. Knox, I think, showed it to me—perhaps not this instrument, but a duplicate, I think.

77 x-Int. How did you come to be a witness in this case, do you know?

A. Well, I was called upon by Mr. Cannon.

78 x-Int. Where were you—up in Massachusetts?

A. Yes.

79 x-Int. Was the instrument taken up and shown you there?

A. No; it was not.

80 x-Int. Was that instrument considered a very surprising and remarkable thing?

A. So much so that his friends generally ridiculed him about it.

81 x-Int. Because it was a talking machine?

A. Yes; because he had such great expectations in regard to it. They thought it was very visionary.

82 x-Int. Did you think that was very visionary when you had a thing that you could talk through?

A. I thought it was a wonderful accomplishment.

83 x-Int. These other people thought it was a very visionary thing?

A. They thought his hopes were very visionary.

84 x-Int. What were his hopes?

A. He expected to use it in the place of the ordinary telegraph. He worked to that end. He hoped to bring it to that state of perfection that it might accomplish that object.

85 x-Int. So far as you know, it accomplished the object, didn't it? You talked through it?

A. I don't know why it did not.

86 x-Int. Didn't he think it was perfect?

A. He was not willing to place it before the public. There were some other things he needed to do with regard to it, but he did not deem it sufficiently perfect to put it on the market. He was intending to do it from time to time, deferring it.

87 x-Int. Did he ever talk about patenting it?

A. Certainly.

88 x-Int. Did he talk frequently about that?

A. Well, I understood that he would patent it, certainly.

89 x-Int. Do you know why he did not?

A. I do not know, unless it was because he had not brought it to that completion which he desired.

90 x-Int. Did he say that about it?

A. Yes; that was the reason he did not bring it out long before. He wanted some time to complete it, to make some little improvement, or what he called completing it, putting it in a more perfect condition in some way.

91 x-Int. And that never got done, so far as you know, then?

A. I do not know why it was not perfect, because we got words through it; but I understood that he had not completed it entirely according to his own idea.

92 x-Int. Did you sell your farm at Northeast where you lived with Mr. Holcomb?

A. No; we did not at that time.

93 x-Int. Did you have a tenant on that farm?

A. He left one there.

RE-DIRECT EXAMINATION BY MR. PECKHAM:

44 Int. Do you know what was the cost of that farm in Northeast?

A. No, I do not. It was a small place; nothing very valuable.

45 Int. Have you any knowledge of what its value was approximately?

A. Well, certainly not over $2,000, I should say, and perhaps not that. It was quite a small place.

46 Int. Do you know whether Mr. Holcomb paid for it all in cash, or whether there was any mortgage on it?

A. I do not know.

RE-CROSS BY MR. DICKERSON:

94 x-Int. He continued to live there during those eighteen months or two years, did he, in carrying on farming?

A. He lived there superintending the work. He had set it out to a vine-yard. He was there the greater part of the time.

95 x-Int. Superintending the work on the farm?

A. Yes, sir.

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By Mr. Peckham: 47 Int. How large a place was it, do you know. How many acres?

A. I should say about forty acres.

Ellen J. Holcomb.

Subscribed and sworn to before me this 9th day of July, 1884.

J. A. Welch,
Special Examiner.

---

29 Wall street,
New York, July 11, 1884,
11 A. M.

Deposition of Professor Henry Morton resumed.

Present:
Mr. Dickerson, for complainants;
Mr. Peckham, for defendants.

Direct-examination continued by Mr. Peckham:

32 Int. Have you examined and do you understand the construction and mode of operation of the instrument known as Exhibit Holcomb Telephone, now shown you, assuming the same to be one of a pair of similar instruments, connected by a line wire and used respectively for the transmission and reception of audible sounds by electricity?

A. I have examined this apparatus and believe that I understand it.

33 Int. Please contrast Exhibit Holcomb Telephone with the instrument described in the patent to Mr. Bell, No. 174,465, particularly in the fifth claim of said patent, and as shown in figure 7 of the drawing, and state whether in your opinion the devices and mode of operation in the respective instruments are the same, or otherwise, and in what respect they are alike or different?

A. Arranged as you have described, the Holcomb apparatus would in my estimation be substantially identical with that described in the Bell patent and shown in Fig. 7 of the same, the differences between them being in all cases immaterial. I, of course, assume that in either case there is a return circuit by the earth or other-

wise, and that a battery may be introduced in the Holcomb apparatus without modifying the substantial character of its operation.

34 Int. You say that the apparatus is substantially identical. Do you mean to include the mode of operation in the term "apparatus?"

A. I do; or rather, I mean that both as pieces of apparatus and in reference to their mode of operation the two instruments compared are substantially identical.

35 Int. Can the instrument Exhibit Holcomb Telephone, assuming the same to be connected with another similar instrument in a proper circuit, metallic or by the earth, operate with or without a battery?

A. Both. It can operate with a battery or without it.

36 Int. Calling your attention to the classification of electric currents made by Mr. Bell in the specification for his patent 174,465, I ask you how you describe the electric current used in the operation in the instrument Holcomb Telephone, whether as undulatory or intermittent, using the same classification made by Mr. Bell in the patent referred to?

A. Accepting Mr. Bell's definition and classification, the Holcombe apparatus would undoubtedly operate by an undulatory current.

37 Int. Please contrast the Exhibit Holcomb Telephone with the instrument described in the patent to Mr. Bell No. 186,787, particularly with reference to the fifth, sixth, seventh and eighth claims therein, and state whether in your opinion the said instruments are the same or not, in substance?

A. In my opinion the two instruments are substantially identical, uuless the claim of the Bell instrument should be construed as limiting the plate referred to, especially in the eighth claim, to a diaphragm entirely of iron or steel, as distinguished from a plate or armature of iron or steel attached to an elastic diaphragm.

38 Int. I call your attention to the Reis-Legat article and to the figure B, being a drawing of the receiver as shown in that article; and I also call your attention to the Defendant's Exhibit Reis-Legat Receiver, which I now show you, and I ask you whether in your opinion a person is instructed by that article to so adjust the receiver that the armature lever shall swing in the manner of a pendulum from the points on which it is pivoted, its motion being arrested by the pole of the magnet in one direction and by the back-stop in the other; or, if not so constructed and used, in what

way do you understand that a person by that article would be instructed to arrange the receiver to the end that it might fulfil the functions which belong to it?

A. I do not think that an intelligent person, reading the article referred to and having a comprehension of the object aimed at, would for a moment suppose that it was intended to so adjust this armature lever as to allow it a free back and forth motion between the back stop and the poles of the magnet, such as you indicate in the early part of your question. On the contrary, I think he would find himself instructed so to adjust this armature lever that it was incapable of any such free motion, but only capable of receiving what might for distinction be called a molecular vibratory movement, such as would serve to transmit and develop musical or other sounds. It is to be considered, of course, that the whole article is a description of an apparatus for the transmission and reproduction of musical sounds or of words. Hence, the receiving and reproducing part of that apparatus was manifestly intended to receive and reproduce such vibrations. Had this armature lever a free movement between stops, as we may call them, at either side, it is manifest that no such rapid vibrations as would be required for the transmission of even musical sounds could be developed in it. It would be fit for operation as a sounder, to transmit taps or successive strokes or the like, but would be manifestly unfit for such rapid movement as is implied in the development of a sound such as we are here considering, that is, of a musical sound or combination of musical sounds such as are produced by the human voice in singing or talking.

39 Int. Calling your attention to Bell Patent No. 174,465, what do you understand the patent to describe as the purpose and function of the instrument particularly referred to in the fifth claim of said patent and shown in Fig. 7 thereof?

A. The special and distinctive purpose described and claimed for that form of the apparatus shown in Fig. 7 is, as I understand, a transmission of such sounds as are produced in common by the voice and musical instruments, by means of an electric current. But I also understand that this apparatus, like the apparatus shown in Fig. 5, was to be used in the general combination indicated in Fig. 6, for multiple telegraphy. In other words, the object of the invention as set forth in this patent was the transmission of many sets of signals at once through a single circuit, and all the methods

47 x-Int. Do you mean to say by that that the letter did not express your sentiments, and you did not know what you signed?

A. I do not; but I mean to state that I had nothing to do with getting up the letter, and did not know, of my own knowledge, anything about the statements contained it. In other words, I was not present at the Centennial, and did not see Mr. Bell's apparatus there, and knew nothing about it except by report.

48 x-Int. When did you first become acquainted with the mode of operation of the instrument referred to in that letter; was it before or after that letter was signed?

A. From my own knowledge, only after the letter was signed. I attended the lecture which Dr. Bell was requested in this letter to deliver, but did not hear on that occasion any speech transmitted, but only musical sounds. After returning, I caused to be constructed instruments in accordance with the description Mr. Bell had given, and then for the first time heard articulate speech through such instruments, and was enabled to observe the manner of their operation to some extent.

49 x-Int. In that letter you referred to published accounts of Dr. Bell's improvements in his "wonderful instrument;" hadn't you seen such publications at that time?

A. I cannot say now whether I had or not. The fact of the statement being in the letter would not involve that I had seen such publications, since, as I have already stated, I simply signed the letter, following President Barnard, who had signed it already.

50 x-Int. Didn't you consider it a very wonderful instrument when you signed that letter, from what knowledge you had of it then?

A. I considered the instrument in its then state of development as a very wonderful one indeed, and still so consider it.

51 x-Int. For several years you have been employed by various defendants in the attempt to defeat the Bell patent, have you not?

A. I have not. I have been called upon in various cases to give testimony as an expert as to experiments made by me, and as to the meaning of scientific terms and the like, but have in no case been employed to defeat Mr. Bell's patent or anyone else's.

52 x-Int. In all these cases you have been employed by defendants who were engaged in the attempt to defeat the Bell patent, have you not?

A. I have been employed in many cases by defendants in suits, although in two cases at least those for whom I acted were not de-

fendants. That is, in the case of John H. Irwin and the Western Electric Manufacturing Company vs. The Metropolitan Telegraph and Telephone Company and the American Bell Telephone Company, my clients were complainants; and in the case of interference between A. G. Bell, Thomas A. Edison, Emil Berliner, Elisha Gray, A. A. Dolbear and W. K. Voelker, my clients were neither complainants nor defendants, but claimants in an interference case. As to the relations of these cases to Mr. Bell's patent, I have not concerned myself beyond this, that, if my testimony was likely to defeat Mr. Bell's patent, it would be only because Mr. Bell's patent was inconsistent with the knowledge on the part of the Court of the facts in the case and of the proper interpretation of scientific terms and the like.

53 x-Int. In all the cases your clients have been adverse to the Bell patent, have they not?

A. They have.

54 x-Int. Now, in the course of your employment during these years by clients adverse to the Bell patent, have you yet discovered any publication or description, before 1876, of a mode of operation in which vocal or other sounds were to be transmitted telegraphically by causing undulations similar in form to the vibrations of the air accompanying said vocal or other sounds to be transmitted over a wire; if so, point out to the Court what publication or description you have found which described that mode of operation?

A. I have found no such description.

55 x-Int. In your direct examination you say that in Bell's patent there is no description of an apparatus capable of transmitting and reproducing articulate speech, so that connected conversations could he carried on between separated stations. Did you mean to say that an apparatus constructed substantially in accordance with the description and drawing of figure 7 was not capable of performing that operation?

A. I did, and to the best of my belief at the present time such statement is true.

56 x-Int. Do you know of any apparatus capable of transmitting articulate speech, unless it operates upon the principle of causing electrical undulations similar in form to the air vibrations accompanying the spoken words; and if so, where is that apparatus to be found, or where has it been described?

A. I do not know of any apparatus about which either I or anyone

else can say positively whether the electrical undulations by means of which spceeh is transferred do or do not resemble the air undulations involved in the spoken words. I consider this statement found in Mr. Bell's patent to be a pure figment of the imagination, which has never been confirmed or refuted.

57 x-Int. Do you mean to say that, in your opinion, the magneto-telephone does not transmit speech in consequence of the fact that the undulations of electricity on the line wire may be graphically represented by similar curves to those which represent the vibrations of air engaged in producing the sound?

A. I mean to say that this is a subject about which we simply know nothing. We do not even know whether there are such things as electric undulations, and we certainly do not know what is the form or character of that action by which energy is transferred from one end of an electric wire to the other. Therefore, while it may be that the magneto-telephone acts in this way, we do not know positively that it does.

58 x-Int. Whom do you include in the term "we" in your last answer, besides yourself?

A. I think the majority of scientific men would agree with me if their attention were drawn to this point.

59 x-Int. Do you consider Sir William Thompson a competent scientific electrician and included within the term "we," and do you also include Prof. Henry in that same category?

A. Sir William Thompson is a man of very high ability who has at various times enunciated his opinions on certain subjects, and within a short time enunciated precisely opposite conclusions which he has come to on further consideration of the same subjects. Prof. Henry is dead many years. I therefore should not consider that my reference was met by prior statements made by either of these gentlemen. What I mean is, that if the point, as I have stated it in the previous answer, were brought to the attention of any competent scientific man, I believe that his unbiased opinion would coincide with mine, while he might easily use expressions, where his attention was not drawn to this point, which would appear to be at conflict with my statements.

60 x-Int. Then you think, do you, that if Prof. Thomposn had the benefit of your present suggestion he would modify this statement of the operation of the Bell telephone, viz.: "The strength of its current must vary continuously and as nearly as may be in simple "proportion to the velocity of a particle of air engaged in constitut-

"ing the sounds." And how do you think he would modify it in order to agree with your views?

Question objected to by defendants' counsel on the ground that there is no evidence in the case that Sir William Thompson ever entertained such sentiments or expressed them.

A. I think he would be quite ready to modify it to the extent of saying that, while the statement you have quoted was a possible explanation of the action referred to, it would be quite possible that other and different explanations might be found and prove in the end to be more consistent with existing facts.

61 x-Int. Will you favor us with an explanation, which, in your opinion, is more consistent with the facts than the one given by Sir William Thompson, viz., that the strength of current on the line shall be in accordance with the variation of the air vibrations engaged in producing the sounds?

Same objections made by defendants' counsel as that made to the foregoing interrogatory.

A. I do not claim to have developed any theory on this subject. What I have already stated is, that in my opinion no certain or demonstrated theory as to the condition of things in the wire connecting the transmitter and receiver of a magneto-telephone had been developed. All we know is, that we can by the use of electric force reproduce, at a distant station, vibrations substantially similar to those caused by the sound motions of the air at the transmiting tstation. This was taught us by Philip Reis, who judiciously left the matter at that point, not claiming to know more than he did as to the electrical conditions of the connecting wire.

62 x-Int. Then you mean to swear, do you, that *we* don't know that the strength of the current on the line wire is constantly varying during the operation of transmitting speech?

A. I mean to swear to nothing of the sort, nor have I said anything warranting such an asuumption. I have said that we do not know that the strength of the current varies directly with the variations of velocity in an air particle, or, to express it otherwise, that we do not know that the current could be graphically represented by a curve substantially identical with that representing the motion of the air particles involved in the sound. In other words, that this

theory as to an identity or close resemblance between the electrical conditions in the wire and the sound motions is a pure assumption, which may be true in certain cases and not in others, or may be true in no case, and is not, in my opinion, in any way essentially connected with the successful transmission of speech by electricity.

63 x-Int. Don't "we" know that the strength of current does vary continuously on the line wire during the transmission of speech?

A. In the sense that it varies in intensity, reverses itself in direction, and between these reversals momentarily ceases, we know undoubtedly so much in the case of the magneto-telephone.

64 x-Int. Knowing that much to be true, is it your opinion that it is a mere figment of the brain to say that those variations correspond with the variations of the air waves which are to be reproduced in sound?

A. It is, for this reason, among others: We know as a matter of fact that sounds being uttered at one end of such a telephone line are very accurately reproduced at the other; and yet we also know that the elastic and other conditions of the diaphragm at the further end do and must induce a considerable modification in the motions otherwise due solely to the change of magnetic force produced by fluctuations in the current. That identical results are produced where two causes are at work, one of which is a new one, or different, seems to me to prove conclusively that the other cause must likewise be modified to compensate for this new or varied action of the other cause.

65 x-Int. It being true that the electric undulations vary continuously during the transmission of speech, do you mean to tell the Court that it is as probable that that variation does not depend upon the movement of the air waves and is not related thereto, as that is entirely independent of those causes and has a sort of variation of its own for which there is no present explanation?

A. Your question assumes what I am not prepared to admit, that there are known to be electric undulations.

66 x-Int. It being true that the strength of current varies continuously on the line during the transmission of speech, do you mean to say that it is not eminently probable that those variations depend upon and are produced by the variations in the movement of the air waves, but that on the other hand there is no probability on this subject, and, for all you can think about it it, those variations have a law of their own entirely irrespective of the movement of the air waves?

A. What I have said and meant to say is this: The variations in current strength (meaning by that what we so call currents in one direction and in the opposite, and intermissions), are undoubtedly produced by the motion of the air waves and bear some relation thereto; but it is in my opinion perfectly possible that where those air motions involve gradual changes, the changes in current strength may be abrupt, or possibly the reverse, in other cases. In other words, that while as a matter of course the air motion is the indirect cause of the electric action, it does not follow that the fluctuations of the latter shall in any close way follow the fluctuations of the other, or that such a distinction as Mr. Bell makes between an undulatory and a pulsatory current of necessity exists in the electric wire transmitting articulate words.

67 x-Int. I am not discussing Prof. Bell's selection of words, and haxe not asked you anything about that question. I am calling your attention to the actual operation of the apparatus. Using an apparatus in which a constant current is maintained in one direction and the strength of it varied by altering resistance on the line, in that case is it a figment of the imagination to say that the relation of the strength of current bears a definite relation to the variation of the air waves produced by the sound, and that the power of the instrument to transmit similar sounds to those uttered in the transmitter depends upon the fact that there is such a definite relation?

A. In the first place, allow me to remark that the subject heretofore under discussion has been the Magneto Telephone. All my answers have been directed to that instrument. Considering now the new apparatus which you suggest, I should say that the probabilities as to the relation of the current strength to the motion of the air waves would depend entirely upon the structure of the individual apparatus, or, in other words, of the means used for changing the resistance. Under certain conditions it is quite conceivable that the fluctuations in current strength might follow the motion of the air waves, and that in other conditions there might be great differences; and yet under both sets of conditions articulate speech might be successfully transmitted. Thus, if the change in resistance involved minute absolute ruptures, I do not think that these ruptures would be represented in any way by the motions of the air. The air might be under such conditions, moving in a way which would be correctly represented by a sinusoid or combination of sinusoid curves, while the fluctuations or changes in the current strength might be only capable of representation by a broken line

with sharp angles, like the profile of a mountain range shown in a geography.

68 x-Int. I have not asked about circuit-breaking apparatuses, and will endeavor to eliminate everything from the question except what strictly belongs to it, if I can. I give you the case of Bell's liquid transmitter, such as was exhibited at the Centennial, in which the strength of current is varied by immersing the electrode to varying depths in the liquid conductor, by the vibration of the diaphragm spoken to. Do you understand that apparatus?

A. I understand your description of the apparatus, but I have never seen it in operation, nor do I know anything about its being used at the Centennial.

69 x-Int. Now with that transmitter and the ordinary receiver, isn't it perfectly certain to you that the variation in the strength of current must bear a constant relation to the variation of air waves, in order that intelligible words should be transmitted over it and heard at the receiver?

A. Undoubtedly the strength of current must bear some constant relation to the motion of the air waves, in order that the apparatus should be operative.

70 x-Int. And is not that just as true in the magneto transmitter as in the variable resistance transmitter of any kind?

A. Undoubtedly it is, and nothing that I have said was inconsistent with that statement.

71 x-Int. Now you have volunteered to swear that Reis taught us all we know of the operation of the telephone, since which time you have admitted that we know that the strength of current varies during the transmission of speech, and that that variation bears some relation to the variation in the vibrations of the air producing the speech. Will you now point out to the Court where Reis describes those two facts as incident to the transmission of speech or as the means whereby speech could be transmitted?

A. In the first place, I have not asserted that Reis taught us all we know about the action of the telephone. What I did assert was that Reis taught us (involving, of course, what we knew already as supplemented by his instruction), that to transmit speech as well as musical sounds, all that was necessary was to reproduce at the receiving station air waves substantially similar to those developed at the transmitting station. And moreover, not only did he tell us that this theoretically could be done, but he demonstrated by actually doing it that it was done. I also stated that Reis did not attempt

to explain the conditions of the electric current in the wire. As to the fact, which I not only admit, but freely state, that the electrical condition of the wire is brought about by the air motion and must of necessity have some relation to it, I do not think that it was necessary for Reis or anybody else to make such a statement as that. When he had told us what he did, and when he had shown us what he did, this followed as a matter of necessary logical deduction which required no invention, discovery or anything else to develope. It was simply the statement that causes and effects must have some relation and mutual dependence. In other words, Reis told us: If you produce a sound undulation at one end of a given apparatus, you will get a similar sound undulation at the other end, the influence being transmitted by an electric current. From this, as I say, it logically follows that the electric current which serves for this transmission must be modified by the sound wave at the one end, and must have its strength, power or the like, by whatever name you call it, changed in some relation to the sound motion which causes modifications in it at the one end, and to the sound development which it causes at the other.

72 x-Int. Then you mean to swear, do you, that the mode of transmission by maintaining an unbroken circuit between the transmitter and receiver and by causing the strength of current on the line to vary in some ratio to the air waves, was the obvious conclusion from Reis' description and apparatus, needing no invention to discover that mode of operation?

A. I mean to say that anyone reading the description of Reis, and constructing and using his apparatus so as to secure the results attained by Reis, would of necessity develope all that is involved in your question: that is, when he used the apparatus for the transmission of speech he would be using it without interruption of circuit and with a current unbroken and continuous, which varied in some relation to the air waves in sound. I do not say that Reis in his description in any way points out or indicates the use of a continuous current. His description seems to be confined to the employment of his apparatus for the transmission of loud musical sounds, and he is silent as to the special conditions which would be involved in the use of the apparatus for the transmission of speech.

73 x-Int. Won't you answer the question, which is this: Did it, in your opinion, require no invention or discovery to construct the closed circuit telephone and to develope the mode of operation

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therein contained, in view of the fact that Reis' apparatus and Reis' description were known to the public?

A. To produce a practically efficient closed circuit telephone did, in my opinion, involve a great many inventions and discoveries in addition to all that was given us by Reis, but it is also my opinion that among these inventions and discoveries the so-called invention or discovery that the current in the wire must express undulations corresponding to those of the moving particles of air, was neither necessary nor important. Reis showed us how to transmitt speech imperfectly. Various improvements, such as the use of carbon in the transmitter and the use of a metallic diaphragm in the receiver, were essential to make this transmission of speech practically available, but in my opinion this practical development was in no way influenced by any notions, correct or otherwise, as to the character of the current in the wire.

74 x-Int. Then, it is your opinion, if I understand you, that the construction of a closed circuit telephone, in which the strength of current, flowing constantly, is varied by the vibrations of the diaphragm, did not constitute any invention, in view of the description and apparatus of Reis; is that what you mean to swear to?

A. That is precisely it, understanding that your definition makes the broad claim only, and does not involve any of the means, such, for example, as those peculiar to the magneto telephone.

75 x-Int. I will try again. Figure 7 in the Bell patent represents a closed circuit telephone, in which the speaker utters a sound in the transmitter and the listener hears a sound in the receiver similar to that uttered in the transmitter, and in which the strength of current along the line is constantly varying with the movements of the diaphragm, under the impulse of the air waves. Now, suppose that apparatus to be operative, don't you think that was a wonderful instrument, and that the principle of its operation was new, notwithstanding what was described in the Reis publication?

A. I do think this was a wonderful apparatus, if operative, and that it would involve many new actions, irrespective of everything found in Reis' publication. In other words, it contained abundant patentable novelty, notwithstanding that, as far as the mode of action in reference to the transfer of speech by means of the electric current is concerned, its operation was substantially identical with that of the Reis apparatus when used for transmitting speech.

76 x-Int. Was it substantially identical with any operation described or pointed out in any of the Reis publications?

A. As Reis has given no description of the operation of his apparatus when transmitting speech, as far as its electric current is concerned, there is, of course no description in such publications of this operation.

77 x-Int. Was it substantially identical with any operation for the transmission of speech known to you, or, so far as you know, to the scientific world, in 1876, and, if you say it was, point out the fact with which you say it is substantially identical, then known to the world as the means of transmitting speech?

A. As far as I am concerned, I know of no method of transmitting speech at the date mentioned. How far any such method was known to the scientific world, I can only answer by reference to such publications as exist, viz., what are known as the Reis publications, and such other matters as have been published recently, containing statements of those who claimed that they knew of such a thing at that date.

78 x-Int. So far as you know from the publications existing in 1876, was the method of operation involved in that Bell telephone, Fig. 7, recognized by the authors of the publications in regard to Reis' or any other apparatus then known?

A. It was not.

79 x-Int. When you were examined in chief as a witness in the case of The American Bell Telephone Company against Spencer, you swore as follows: "Fully realizing all this, however, it seems to me in no " wise to influence this conclusion to admit that the Reis telephone " actually did embody the feature of a fluctuating or undulatory " current corresponding to changes in pressure between the elec- " trodes, produced by the air vibrations constituting the spoken " words. For this feature, though it undoubtedly existed in the " Reis instrument when used to transmit articulate speech, was not " recognized by the authors describing it, and would therefore have " furnished no information which would have enabled the supposed " manufacturer to have constructed an operative telephone under " the conditions above stated." Do you wish to take back any part of that answer now, if so, do it?

A. I do not, but simply add that a knowledge of this feature would not in my estimation, even had it existed, exert any influence on the development of the art of transmitting speech by electricity, or in other words, would not have any influence in developing the improvements which have been made in this direction since Reis.

80 x-Int. Then your opinion is, I suppose, that Bell's invention

did not exert any influence upon the development of the telephone as it now exists?

A. Bell's invention, as expressed in patent 174,465, did not, in my opinion, exert any influence on the development of the art of telephony. Had he left the matter there we should have been no better off to-day than prior to that patent, as regards this subject. It was what Mr. Bell did after the date of this patent which, in my opinion, was of importance in this connection, for it was after that that he made and published to the world the invention of an operative telephone. What he published to the world in this patent is, as I have frequently said, a system of multiple telephony, and what may be called a singing or musical telephone.

81 x-Int. What is there in the principle of any known magneto telephone that differs from Fig. 7?

A. Everything that makes it operative.

82 x-Int. What principle of action is there in any one not shown in Fig. 7?

A. In some the use of an iron diaphragm, which, if vibrated opposite an electro magnet, produces currents of sufficient power to practically affect a corresponding instrument at the other end of the line. Also, in this diaphragm is involved the resistence to the effects of moisture, which are fatal, in the apparatus shown in Fig. 7, to any continuous use of the instrument. Precisely the same statement may be made with reference to the receiving instrument, in which the substitution of an iron diaphragm for the membrane, connected with an armature, changes the apparatus from a practically useless to a thoroughly efficient one.

83 x-Int. Do you consider those changes to involve any new principle of action, or to be only an improvement in details, whereby defects of construction are avoided?

A. I consider them to be so vitally important in their effect that they render the apparatus a substantially different one. It is true that in a sense the principle of action, viz., the production of an electric current, by the movement of an armature or other mass of iron, in front of a magnet, is the same. But this is a principle which was not new at the date of the Bell invention, but was employed in very many forms of apparatus before this.

84 x-Int. Perhaps you can select one form of apparatus out of the very many, in which an armature is made to vibrate in unison with air waves of sound, and excite an electric current in unison

with itself, for the pnrpose of transmitting speech. Refer the Court to just one of such apparatuses?

A. I have not stated that an apparatus containing all these combinations of parts and offices existed, but simply that this mode of action of the apparatus was old, as illustrated, for example, by Bréguet's apparatus for firing blasts, or the various forms of magneto electrie apparatus where currents were produced by rotating or otherwise moving armatures in the front of magnets, as, for instance, in the apparatus described by Sir Charles Wheatstone in the first volume of the "Telegraphic Journal," 1873, page 4.

85 x-Int. Don't the magneto telephone have that combination and operation in it, whether the diaphragm is made of membrane, with an armature attached to it, or of iron, in which the armature and diaphragm are one?

A. Undoubtedly. I have just said so.

86 x-Int. Now you have said that the Legat Receiver was not described as having a pendulum action, and that the vibration which it does have is molecular, and not of the entire mass. Now I refer you to this sentence of the description: "The lever *i*, with the armature, is suspended from the standard *k* in the manner of a pendulum, its motion being regulated by means of the screw *l* and the spring *q*." Will you be good enough to tell us what "the motion" means in that case, if not the swing of the armature under the effect of the magnet and spring?

A. It means, I think, manifestly, such a vibration of that armature as would develope in it musical sounds, this vibration or motion being regulated by means of the screw and spring. In other words, it will be noticed that in the description which you have quoted it is said that the lever, with the armature, is suspended from the standard *k* in the manner of a pendulum; this referring manifestly and emphatically to the mode of suspension, not to the mode of action. It is not said that this lever is arranged to act like a pendulum, but that its manner or mode of suspension is similar to that of a pendulum. When its motion is referred to, it is stated that this is regulated by means of the screw *l* and the spring *q*. Of course such a description as this is very brief, because the adjustment is left to the intelligence of the operator, which, as I have said, would unquestionably teach him that to get the effects desired with an armature lever constructed as is this one, it would be simply absurd to allow a free motion, but that it would be necessary so to bind it that it should be capable of this which I

have called for distinction molecular vibration, rather than massive swing of the body as a whole.

87 x-Int. Then, as I understand you, the design is to strain that armature hard against the stop, so that the magnet is unable to start it against the tensile strain of the spring?

A. Not exactly that, but so that the magnet is unable to pull it away. In other words, we have the strength of the spring holding it with an elastic force; if this is unresisted, the body remains at rest; if it is resisted by no matter how little, there will be a corresponding movement of the body away from the direction in which the spring pulls it, when the adjustment is as it should be.

88 x-Int. Then do you mean to say that the magnet is to be strong enough to pull the armature some distance, and not strong enough to pull it all the way, against the strain of the spring, the magnet increasing its power with enormous ratio as the distance diminishes?

A. I mean to say that the adjustment is to be such that when the magnet acts it can draw the armature towards it to a very slight extent, perhaps the distance of a fiftieth of an inch or possibly less, and that when it has accomplished this much the increased tension of the spring will be so much greater than the increased attraction of the magnet that no further motion in the direction of the magnet is possible. And I say this not on the ground only of theoretical knowledge, but of actual experiment with this very piece of apparatus, which shows me that this is precisely what it does.

89 x-Int. Show us where the description instructs you to construct a spring whose resistance will increase more rapidly than the rate at which the magnet attracts, viz., inversely as the square of the distance, so that the spring will allow it to travel a fiftieth of an inch and then accumulate resistance greater than the increasing power of the magnet.

A. In the first place, with this apparatus it is entirely unnecessary that any such instruction should be given. We are told to regulate the movement of the armature by the use of the spring and the screw. Now, it is simply necessary to make such an adjustment that a large part of the strength of the spring is antagonized by the action of the screw, whereupon any such arrangement as you suggest becomes perfectly unnecessary, because, as soon as the attraction of the magnet causes a minute forward movement of the armature, the pressure from the screw is relieved and the spring obliged to do the whole work.

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90 x-Int. As you understand the description, is that armature to be visibly still or to have a visible vibration?

A. Only to have a visible vibration as a tuning fork has; that is, if sounding very loudly it ought to be possible to see a slight tremulous motion, but when sounding as in the transmission of speech it ought not to be visible to the unaided eye.

91 x-Int. As the instrument is described in operation, there are five cells in circuit and the circuit is opened and closed at each air vibration. Now, in such a case as that the magnet would have the strength due to a five cell battery, and alternately no strength, the spring, as you understand it, being screwed up so hard that the five cell strength would not pull away the armature. Do I correctly state your understanding?

A. You do.

92 x-Int. Now, suppose you used a microphone transmitter and that apparatus. In that case the five cell battery would be constantly pulling, would it not?

A. To a greater or less extent; that is to say, more or less strongly, it would.

93 x-Int. In such a case is not the variation and strength of current an exceedingly small percentage of the total power?

A. It may be or it may not be. That would depend upon the degree of change in the microphone transmitter.

94 x-Int. For the purpose of ordinary conversation is not the variation in the strength of current exceedingly small?

A. I think it is.

95 x-Int. Now, do you think that that apparatus in which a five cell battery is employed and which is described as a circuit breaker was constructed to be held fast by that spring, so as not to give way under the maximum strain, and at the same time to be an operative instrument with a microphone transmitter?

A. I have not a doubt of it, because it is operative under exactly those conditions, not as a practical commercial instrument, but in the sense in which we say a thing is operative when it may be made to go.

96 x-Int. You have said that Fig. 7 in the Bell patent was designed as a multiple telegraph. Now, will you explain to the Court how you think Mr. Bell intended Fig. 7 to be operative as a multiple telegraph, as you read the specification?

A. I have not said exactly what you state, but that Fig. 7 was intended as a singing telephone, which could be used in the sys-

tem of multiple telegraphy set forth in the patent No. 174,465. As I understand it, it would be used in the following manner: A series of such instruments as A, of Fig. 7, would be placed as transmitters at one or more stations, and a series of instruments such as L, as receivers at other stations, all being connected in a continuous series. Then, by prearrangment, signals would be given in the different transmitters by singing or by sounding a musical instrument so as to produce a given note, whereupon the signals made in that note could be recognized in the receivers and could be picked out by ear or by the use of a resonator so as to be distinguished from other signals produced in other notes at the same time. It would be an obvious arrangement, of course, to so construct the instrument that each instrument might become in turn either receiver or transmitter, by simply shifting the cone, everything else being identical.

97 x-Int. And that arrangement is what you think is described in patent 174,465, is it? when the patentee describes Fig. 7?

A. That is the arrangement which I suggested by the presence of Fig. 7 in this patent, though there is no description as to its use in that connection there given, this use being, as I think, manifest from the general context.

98 x-Int. But you are quite sure it was not designed for one person to utter sounds in A and another person to hold the cone L to his ear and hear similar sounds to those uttered in A?

A. On the contrary, that is exactly how it was intended to be used when employed as a singing telephone as well as when employed as a multiple telegraphic instrument.

99 x-Int. But if a man couldn't sing, then he couldn't use the instrument, as I understand?

A. Oh, yes. He could get somebody else to sing, or he could use a musical instrument, as the patent suggests.

100 x-Int. So, that according to the instruction of the patentee, as you understand it, for anyone to use this instrument, he must either provide a musical instrument or get someone who could sing; otherwise he could not utter his own voice in it and have that understood by the sound which he uttered reaching the ear of the listener?

A. Not if he undertook to talk in it, for two reasons: in the first place, because, after repeated and careful trials, I have never been able to hear a word through it, and in the second place, anyone who was drawing up such a patent and knew that such a result as

the transmission of speech could be obtained, could only have failed to state it in plain words through an intention to conceal and mislead.

101 x-Int. Then you think that when Mr. Bell said that the human voice might be uttered into A and that a similar sound to that uttered into A would proceed from L, he only meant that to be true in case the human voice was sung, as you understand the entire language?

A. Beyond a question, that and only that is precisely what that phrase means, taken in its existing connection. What Mr. Bell meant would depend upon what Mr. Bell knew at the time. According to his own testimony, as I recollect it, he had never heard a word transmitted through such an apparatus at the time this patent was drawn. If, on the other hand, he had succeeded in this direction, and knew that the apparatus would operate as a speaking telephone, then I should be unwillingly obliged to conclude that he had deliberately used language intending to conceal what he knew and to mislead the public.

102 x-Int. Had he heard singing through the thing at that time, as you understand his testimony or the facts, in consequence of which he meant singing when he said "the human voice?"

A. My recollection is that he testified to having heard sounds, such as shouting.

103 x-Int. Then why don't you say that he meant by "the human voice" shouting, in place of music, since you give a construction to the patent by what you think he swore to?

A. In the first place, I do not found my construction of the patent upon Mr. Bell's testimony, but simply upon the internal evidence of the document itself, which I think is perfectly conclusive in this direction. As to the question whether shouting or singing was intended, I should say that I do not consider that shouting or any other inarticulate sound is suggested and indicated in the patent, but, of course, wouldbe inapplicable where the instrument was used for multiple telephony where a fixed musical note would be essential. Where it was simply used, however, as a singing telephone, then shouting or any other mode of producing a noise of inarticulate character would, I think, be indicated.

104 x-Int. Don't you know it to be true that any telephone instrument capable of complying with the conditions described in that patent must necessarily be capable of transmitting articulate speech, and don't you think that Prof. Bell knew that as well as you?

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A. I do not know, in this sense, that it is simply a question of degree. An instrument complying with the claims of that patent absolutely would undoubtedly transmit speech, but that Mr. Bell did not know that the instrument proposed by him had the capacity of so complying with those claimed conditions is, I think, perfectly manifest from his conspicuous silence throughout the patent in reference to any such action as the transmission of articulate speech.

105 x-Int. Isn't it perfectly certain that in such an instrument as is shown in that drawing, Fig. 7, if in fact, to use our own language in the Spencer case, already quoted to you, "there was a fluctuating or undulating current corresponding to the changes in the air vibrations, whereby a similar sound to that uttered into A will proceed from L,"—that such a machine must necessarily be a talking machine?

A. Assuming the facts to be as you state, in reference to this particular instrument, and also that the sound proceeding from the receiving instrument was sufficiently intense to be audible, undoubtedly the machine would transmit speech, because, in other words, your assumption or definition is equivalent to saying that it did transmit speech.

106 x-Int. And don't you suppose that the man who conceived of that theory of action and constructed an apparatus in conformity therewith knew, as certainly as any man knows in respect to a machine which he has not reduced to practical operation, that it would transmit speech if properly made?

A. I do not. On the contrary, with all that theory fully developed and explained, I should be in profound doubt as to the operativeness of any such apparatus prior to experiment demonstrating the same; and if in this case I had further constructed the apparatus and on repeated tests had failed to obtain any successful result, such doubts would be reduced to a reasonable degree of certainty, and I should say, "the theory is excellent, but the natural conditions involved in the problem, which theory is unable to treat and discuss, so seriously modify the results that my hopes of success are proved to be unfounded."

107 x-Int. I have not asked you what would you think on the subject, not having been the inventor of this thing. My question is directed to the man capable of having conceived that mode of operation and of having stated it in the form in which it now stands before the world, accepted, I believe, by scientific people everywhere, as the

best known statement of the phenonemon: and in respect to him I ask you, in view of what the fact has developed, whether you do not think he was justified in believing that such an apparatus as that was necessarily a talking machine, particularly if he believed it was a good singing machine?

A. I can well conceive that Mr. Bell, before he made any experiment with the apparatus, may have hoped that it would prove successful as a means of transmitting articulate speech; but that he should have *known* any such result would be, in my estimation, to claim for him prophetic power. After he had made an experiment and found this to be a failure, he would be still further from any such knowledge of necessary success. So far in reference to mere conclusions on general principles. In this patent itself, however, Mr. Bell has, in my opinion, given conclusive, direct and positive testimony that at the time of drawing the same he was so far from knowing that the apparatus would be successful that he did not venture to state even his hopes, but drew a patent and described this apparatus without the faintest hint that it could be used as a means of transmitting articulate speech, when such an announcement, he could not but know, would excite universal attention and interest and give to the patent an incalculable value.

108 x-Int. And under those circumstances you think he calls it a singing machine, and not a talking machine, in his patent, in substance?

A. And under those circumstances he described it for what he knew it to be and not for what he may have hoped it might become in his hands or the hands of some one else.

109 x-Int. Which was a singing telephone, if I understand your testimony?

A. His description of it is the description of a singing or non-articulating telephone.

Adjourned to July 12th, 1884, at 11 A. M.

J. A. WELCH,
Special Examiner.

29 WALL Street, NEW YORK, }
JULY 12th, 1884, 11 A. M. }

Met pursuant to adjournment.

PRESENT—

MR. DICKERSON for complainants: MR. PECKHAM for defendants.

Deposition of PROF. HENRY MORTON continued:

CROSS-EXAMINED BY MR. DICKERSON:

110 x-Int. In your twenty-fifth direct answer you drew a distinction between what you call a voltaic current and a magneto current. Do you really mean to say that there is any distinction between the electric current generated by a magneto machine and by a voltaic battery, and if you do, tell the Court what it is?

A. In the general sense that an electric current is an expression of a certain disturbance or distribution of electrical condition along a conductor, there is no difference between what is commonly called a galvanic and a magneto current; but when we come to study the details of these two actions there are certain marked differences between them. That is, conditions will subsist in a current produced magnetically which are not found under like conditions in a galvanic current. For example, the nature of the fluctuations or increments and diminutions in a magneto currrent are as a rule different from those which we find in a galvanic current. In this sense it is proper to make use of the two words as indicating things which are sufficiently different to authorize the use of distinctive terms; but of course it is not intended by this to claim that in a general and broad sense there is any absolute difference between any one electrical current and any other,

111 x-Int, Do you mean by all that to say to the Court that while there may not be a difference in the broad sense, there is in a specific or narrow sense such a difference as that a magneto current would operate differently in the Bell telephone from a galvanic current, so that in one case the machine would be operative, and in the other, not, or that the operations would be different in reference to the problem of speaking?

A. I mean to say that the differences are sufficient to make it necessary to employ different instruments when we propose to use what is generally understood by electricians as a galvanic current, in place of a magnetic current as indicated in the Bell patent in reference to figure 7. In other words, we should have to convert the

transmitter into a microphone, when it would cease to be, as it is now, an instrument of double office, capable of acting both as transmitter and as receiver.

112 x-Int. That is specific, and as I understand it you mean to say that in an apparatus substantially like figure 7, a magneto machine could not be substituted for the battery there shown, with a like effect, and that in a microphone transmitter a battery and magneto machine are not convertible terms?

A. I do not intend anything of the sort. If a magneto machine were substitued for the battery in Fig. 7, it would then leave the effective current by which the apparatus was operated, or, in other words, by which speech was transmitted, if such a result was obtained, a magneto current, just as it was before, the current supplied by the magneto machine in place of the battery serving no purpose and having no effect except to excite the electro magnets so as to render it possible for them by reaction with the armatures, to develop what are known as magneto currents. In order that this apparatus should be operated by a galvanic current, it would be necessary that the magnets and armatures in the transmitter should be removed and some device substituted capable of producing changes in a galvanic current by which speech should be transmitted. By a galvanic current I mean of course, primarily, such a current as is developed by a galvanic battery, and of course do not mean to deny that by special arrangements we can obtain from a magneto machine a current practically identical therewith; the distinction, as I have said, between the magneto and galvanic currents, not being in nature or in essentials, but in details or modifications which may or may not exist in special cases.

113 x-Int. Won't you answer the simple question with a yes, or no; don't you know that if a magneto machine were substituted for the galvanic battery in an apparatus substantially like Fig. 7, the operation would be substantially the same as it is with a battery, without any changes in the rest of the apparatus at all?

A. I do not know any such thing, in a general sense, because it would depend entirely upon the character of the magneto machine used. If the magneto machine employed yielded such a current as is known among electricians as the characteristic magneto current, the apparatus would be entirely inoperative, but if the magneto machine were so constructed as to produce a current practically equivalent to a galvanic current, then, of course, the apparatus would act

just as it does now, operating then by a magneto current self-generated in the apparatus itself.

114 x-Int. When you answered this last question didn't you know that the ordinary magneto machine, such as is used in telegraphy, does generate just such a current as a battery generates, and is a simple equivalent for a battery current in telegraphic operation?

A. I know, of course, that the very complex magneto electric machines, with numerous special appliances, which are used as substitutes for galvanic batteries in telegraphic work, yield currents which are practically identical with those obtained from batteries, and I have had this in mind since this topic was first started and have carefully framed my answers so that they should be entirely consistent with this fact. Nothing that I have said is in any way in conflict with or fails to recognize the fact that we may produce, by the use of magnets, currents equivalent to what are known as galvanic currents; but of course, when this result had been obtained, the currents so produced have lost the recognized characteristics of magneto currents, as that term is used to indicate a distinctive property or quality in currents.

115 x-Int. Will you tell the Court what are the distinctive characteristics of magneto currents which are lost in the magneto machine used in telegraphy?

A. The most prominent characteristics of magneto currents, as distinguished from galvanic, is their constant fluctuation or irregularity, reaching the extent, in most cases, of complete reversal as to direction; and this, as I understand, is the idea which the word conveys when used as a distinctive term.

116 x-Int. Then, as you understand the term, electro-plating by magneto machines is not done by magneto currents?

A. In a certain sense you are correct; that is to say, the term "magneto currents" is used in two different senses. It is used as a distinctive term, as I have already pointed out, to discriminate between the characteristic current developed by the action of a magnet, and the characteristic current developed by the action of a battery. But it is also used without any such idea of distinction as to the character of the current, as a means of indicating the source of that current, whether it is a battery or a magneto machine; or, as it is more commonly called, dynamo-electric machine. As a constant and steady current is necessary for electro-plating, the dynamo machines employed in that work are so constructed as

to yield currents as uniform, constant and regular as possible, and, therefore, such currents, as regards their character, might be very properly called galvanic currents, while as regards their origin they are with equal propriety called magneto currents.

117 x-Int. Can you refer the Court to anything in print or in writing, excepting this last answer, in which the dynamo machine currents are called galvanic currents; if so, tell us in what book such a name is given to them?

A. Having no books treating on such subjects with me, it is of course impossible for me to furnish at this moment any reference, and I feel perfectly confident that what I have said in reference to them in my previous answers is in entire accordance with everything which has been published by scientific writers on the subject.

118 x-Int. At your leisure please give us the reference to a publication in which currents from dynamo machines are called galvanic currents, in any book or publication whatever, and I will consent to have it put into your deposition at any time.

A. I will do so.

119 x-Int. Now, in view of your last explanation, is there any difference whatever in the effect produced, or in the manner of producing it, so far as the telephone is concerned, whether dynamo machine currents, such as you have described to be used for plating and telegraphing, or battery currents, are employed?

A. None whatever; the current under those circumstances would have no direct effect in the operation of the instrument, as I have already pointed out; said operation being carried out by the definitely magneto current developed by the instrument itself.

120 x-Int. I will try again. In an apparatus like Fig. 7, a galvanic battery is represented as an essential part of the operation. In microphone transmitters, generally speaking, a galvanic battery is used to produce the current over the line. Now, in either of those machines, does it make any difference whatever in the operation or effect, whether a dynamo machine of the kind you have described, be substituted for the batteries; the one shown in the drawing and the other indicated in the question?

A. It would make no difference; but at the same time it would be just as true as ever that Fig. 7 would operate as a telephone, if it did so at all, by what is known as a magneto current distinctively; and that the microphone, whether the current applied to it came from a battery or a properly constructed dynamo, would be of ne-

cessity operated by what is known as a galvanic current distinctively.

121 x-Int. Then you mean to swear, do you, that when a dynamo machine makes a current flowing in one direction, that ceases to be a dynamo current, and is a galvanic current?

A. I mean to state that when a dynamo machine produces a current so uniform as to possess the characteristics in that respect of a galvanic current, that it is to all intents and purposes a galvanic current, and would be so regarded by any competent electrician?

122 x-Int. And does not a competent electrician also know that a battery current is sometimes irregular and sometimes reverses itself?

A. Not in the sense in which we use those terms in reference to a magneto current.

123 x-Int. Doesn't he know that the current will sometimes flow one way and sometimes another, from the same battery?

A. Never, except under unusual and abnormal conditions, such as the extreme polarization or exhaustion of a battery or the like.

124 x-Int. Does not that tendency in galvanic batteries have to be specially guarded against in order to prevent the mischief they will do in a plating operation?

A. Not in any such sense as it has to be provided against with dynamo machines, nor is any such complete reversal as we have in the case of a magneto current possible as in the case of a battery.

125 x-Int. Then you mean to say, do you, that a battery will not at times completely reverse itself, so that the positive end becomes negative and the negative positive, the current flowing first in one direction and then in the other?

A. If any such action as that happens in the battery itself, it is an extremely unusual one and can only occur under peculiar conditions. You probably have in mind quite a different fact, that when a battery is connected with a plating bath, it will establish opposite polarities in the cathode and anode of the plating bath, and if the strength of the battery should greatly diminish, this opposing battery in the plating bath might reverse the current; but this is, of course, a totally different thing from a reversal in current from the battery itself, and either of these actions is, as I have said, one of relatively rare occurrence, resulting from the exhaustion of a battery after many days of use, while the fluctuations of a magnetic current, to which I have alluded, occur as a

rule in magneto machines and the like many times a second and are part of the normal action of the apparatus.

126 x-Int. And when a battery does reverse itself, do you call that a dynamo current as distinguished from a galvanic current, and where do you find that name given to it?

A. I do not; such reversal being totally different in character and effect from the reversals characteristic of magnetic currents.

127 x-Int. Don't you know that the reversal of current in magneto machines has nothing to do with the fact that the current is generated magnetically, but depends entirely upon the fact that the machine is so organized as necessarily to reverse the current at each passage of the armature, whereas if the machine is differently constructed the current will be continuous; in both cases it being generated by magnetism instead of by a battery?

A. I have already repeatedly tried to make it clear to you what is the origin and meaning of the term "magneto current" as distinguished from "galvanic current," but, as I do not appear to have succeeded so far, I will try again. Faraday, a long while ago, discovered that when a conductor was moved in the vicinity of a magnet so as to cut what are known as lines of magnetic force, a current was produced in such conductor which, in consequence of the method of its production, was called a magnetic current, or rather a magneto current, to distinguish it from another theoretical term. This current possessed certain peculiar and distinctive qualities, among which the most striking, as I have already stated, was its changeable and reversible character, as the result of this it has become usual among electricians to speak of such a current as this as a magneto current, not meaning thereby to refer to its origin or source in a magnet so much as to its character. This is the sense in which I have used the word in my answer to direct question 25, as I have already explained. While the word has received this meaning when so used, it has also, in the ordinary business connections of the subject, been used as a term to indicate the source of electricity, so that in that connection we would speak of a current coming from a magneto machine as a magneto current, irrespective of its characteristics, and in that sense the word would have no meaning as a distinction between one current and another, in reference to any characteristic or property of said current. It simply refers to the source of the current, without in any way describing it or indicating its purpose. I have already, in several previous answers, stated that a magneto machine might be and

frequently was so arranged as to produce a current which had none of the qualities indicated by the term magneto current when used as a descriptive word; and, therefore, I have already stated what I understand you to ask about in this question, viz., that the character of the current yielded by a magneto machine depends upon the construction of the machine, and may be, and is in certain cases, a practically uniform current, having, therefore, none of the characteristics indicated by the use of the term magneto current when that is employed as a description or indication of the properties of a current and not simply of its source.

128 x-Int. In the Spencer case, when speaking of the action of the Reis transmitter, you say: "In that case a rupture of contact, when it did occur from too loud speaking or an intentional movement of the lever. produces a violent rattling noise utterly inconsistent with the transmission of words." Now are you still of opinion that a rupture of contact between the electrodes of the transmitter is utterly inconsistent with the transmission of words, or have you changed your opinion since that time?

A. I am still of opinion that any such rupture of contact as I there refer to is inconsistent with the articulate transmission of speech, but various statements which I have heard from others lead me to be at present of the opinion that very minute ruptures of contact are consistent with the transmissions of articulate speech, or, still further, that articulate speech may actually be transmitted by means of successive minute or brief interruptions.

129 x-Int. Have you any knowledge of your own to the effect that in a speaking telephone a rupture of the electric current can be so made as to produce articulate speech?

A. I have no such knowledge from my own observation.

130 x-Int. Is there any substantial difference in principle or mode of operation between the transmitter of the defendants in this case and the transmitter in the Spencer case, or the Blake transmitter, so called?

Question objected to by defendants' counsel for the reason that the identity of the defendants' transmitter with either that of Spencer or Blake is immaterial, and further, that neither the Spencer nor Blake transmitter is in evidence in the case.

A. As to the identity or similarity between the structure and mode

of operation of the transmitter referred to as defendants' transmitter, and the Spencer and the Blake transmitters, I can only say that in structure defendants' transmitter is entirely unlike the others, and as regards its mode of operation I do not feel myself able to say with any certainty exactly what that mode is. When I first saw this transmitter, the impression it produced upon my own mind was that, had I not been informed, under circumstances that compelled my belief, that it was operative, I should have felt very confident that it was not, and except to convince myself by actual trial that it was operative, I have made no examination of it which would enable me to say with certainty how it does operate. The fact that it operates at all is in my opinion as surprising as anything connected with the subject of telephone transmission.

131 x-Int. Don't you think you are able to say, upon reflection, that each of the spokes of that transmitter is an ordinary Hughes microphone, as commonly shown in the books of electricity?

A. In form, yes; in operation, it seems to me not; because if each of them acted independently it would appear to me necessary that one would destroy the effect of the other, and that the effect of their multiplication would simply be to destroy the operativeness of the apparatus.

132 x-Int. Then you mean to say, do you, that the effect upon the current transmitted through one of those spokes is not the same as the effect in the case of the Hughes microphone?

A. I am unable to speak positively about it, but my belief is that it must be different, for the reason that I have stated.

133 x-Int. Taking one of those spokes by itself and passing the current through it, isn't it exactly the Hughes microphone in construction and operation?

A. It would correspond substantially with one of the forms of the Hughes microphone.

134 x-Int. But you think that if you put two or more of them together, then the principle and mode of operating becomes different, and it ceases to be a microphone; is that your idea?

A. If several of them are put together as they are in this instrument, it seems to me that their mode of action must be radically changed. Whether the entire apparatus might be still called a microphone, would depend upon the breadth given to that word. If it means any transmitter in which loose contacts are used, this apparatus would undoubtedly still be a microphone?

135 x-Int. If it means an apparatus in which carbon points

rest upon each other and a current is passed through the joint or joints between those points, is this defendant's transmitter a microphone?

A. Your definition would of course include many things that were not microphones, but, allowing for this, this apparatus would be within your definition.

136 x-Int. And is not the effect produced, for the purposes of a transmitter, by the variation of pressure between the points of contact, produced by the vibration of the diaphragm supporting those points of contact?

A. It may be, but my impression is that it is produced rather by numerous minute ruptures occasioned at different parts of the countless contact points in this apparatus, than by the changes in pressure only.

137 x-Int. Then you mean to say, if I understand you, that perhaps this apparatus is a circuit-breaker, and interrupts the current, whereas the Blake transmitter maintains a continuous current?

A. I do. I consider this to be very possibly the mode of action in this transmitter.

138 x-Int. Do you believe it to be true that this transmitter makes and breaks the electric current, whereas the Blake transmitter does not?

A. I believe that this transmitter makes and breaks the current at numerous points during its operation, though I do not think that it interrupts the entire current or interrupts the current everywhere at any one time. In the Blake transmitter, it is my impression that there is never any rupture or renewal of contact, but that there is simply a variation in the minute distance, probably something less than a two-thousandth of an inch, by which the electrodes are separated, such separation being consistent with what we know as mechanical contact. In other words we say that two bodies are mechanically in contact when they are separated, as a matter of fact, by a distance not greater than a two-thousandth of an inch; and it is my belief that the action of the Blake transmitter depends upon motions of approach and recession between the electrodes included within this distance.

139 x-Int. So that in both cases the current is continuously flowing through the apparatus. and the effect is produced by a movement of the opposite parts, whereby greater or less resistance to the flow of the current is produced; is not that what you mean?

A. That would be one way of describing it, and a correct way.

RE-DIRECT EXAMINATION BY MR. PECKHAM:

140 Int. Professor, you yesterday said that you would bring the Bell instruments to which you referred, have you done so; and if you have, will you produce them; and I offer them in evidence and ask the examiner to mark them?

A. I here produce the apparatus, and would mention that last evening, on making a further experiment with it, I succeeded, by using the transmitter as a transmitter and a very sensitive magneto receiver of a modern form as a receiver, in getting a moderately distinct articulation, though I had previously failed in a similar attempt. I then repeated my previous experiments, using both the Bell instruments as transmitter and receiver, but failed entirely in getting any articulation under those circumstances. I would mention that the attachment of the magnets in these instruments I now notice to be loose, but they were not so when I used them. In fact, during some of my experiments I substituted an adjustable clamp for the screws by which these are held together, and was thus able to vary the distance between the magnet and the armature, and did so vary it, and tested both instruments under a great variety of conditions as regards the adjustment of this distance. I then put them together with the screws that are in them now, and tested them again, finding that they operated as I have said. The looseness of the screw is the result of some jarring in carrying them over.

Defendant's counsel offers said two instruments in evidence and the same are marked respectively "Defendants' Exhibit Bell Telephone Receiver," and "Exhibit Bell Telephone Transmitter," "J. A. W., Special Examiner, July 12, 1884."

141 Int. I understood you to say in your cross-examination that the precise action of the current in the wire, especially as to the character of the curve by which it could be represented, is not known. I ask you whether it is known what the electric current is, or what is the precise phenomenon which we are accustomed to designate as a current of electricity?

A. I think it is universally admitted by all writers on this subject, that we really have no knowledge whatever as to the final cause of an electric current or other electric phenomena. As to the views entertained by the highest recognized authorities on this subject, I

would refer, in the first place, to a passage in a work entitled "A TREATISE ON ELECTRICITY AND MAGNETISM," by JAMES CLARK MAXWELL, in which, on page 182, of Vol. II., I find as follows:

"552. It appears, therefore, that a system containing an electric "current is a seat of energy of some kind; and since we can form "no conception of an electric current except as a kinetic phenom- "enon, its energy must be kinetic energy, that is to say the energy "which a moving body has in virtue of its motion.

"We have already shown that the electricity in the wire cannot "be considered as the moving body in which we are to find this "energy, for the energy of a moving body does not depend on "anything external to itself, whereas the presence of other bodies "near the current alters its energy. We are therefore led to inquire "whether there may not be some motion going on in the space out- "side the wire, which is not occupied by the electric current, but in "which the electro magnetic effects of the current are manifested.

"I shall not at present enter on the reasons for looking in one "place rather than another for such motions, or for regarding these "motions as of one kind rather than another. What I propose "now to do is to examine the consequences of the assumption that "the phenomena of the electric current are those of a moving sys- "tem, the motion being communicated from one part of the system "to another by forces, the nature and laws of which we do not yet "even attempt to define, because we can eliminate these forces "from the equations of motion by the method given by Lagrange "for any connected system."

I would also refer to the work entitled "Electricity and Magnetism," by Fleeming Jenkins, in which, on page 1, I find as follows: "There has been much wrangling as to the hypothesis of one and "of two fluids. It is quite unnecessary to assume that the phenom- "ena are due to one fluid, two fluids, or any fluid whatever; but in "this treatise the names employed will be chiefly those which have "been suggested to men of science by thinking of electrical phe- "nomena as due to the presence or absence of a single fluid."

I would also refer to the work entitled "An Introduction to the "Theory of Electricity," by Linnaeus Cumming. On page 135, I find as follows:

"147. We have explained above in connection with Faraday's "Theory of Induction, the state of a medium acted on by electrical "forces (Art. 74). We then established

" (I). That in each molecule there was a separation of electricity " along the line of force, through the molecule, the quantity sepa- " rated being measured by $\pm \frac{F}{4\pi}$ unit of area, where F is the result- " ant force at the point.

" (II). That this electrical separation produces or is produced " by a strain in the medium along the lines of force, from which " strained state the medium tends to return to a neutral state by a " discharge from molecule to molecule through the medium.

" (III). That this discharge constitutes conduction resulting in " a transfer of the positive electricity separated to the place of " lower, and of the negative electricity separated to the place of " higher potential, the lines of flow being the lines of force, and the " quantity of electricity neutralized along a tube of force being " $\pm \frac{1}{4\pi} F\sigma$

142 Int. Is it not quite possible, or even probable, that while air movements in front of the diaphragm would be represented by one set of curves, the electric variation in the wire caused by the vibration of the diaphragm would be represented by quite other and different curves or by lines which would more properly be described as angular than curved?

A. I think it is not only probable but certain, that the lines properly representing the electrical conditions brought about by the movement of the diaphragm will be very different in character from those which correctly represent the motions of the air particles. This is manifest, among other things, from the following considerations: an air wave consists of countless particles of air in various rates of motion, or moving with various velocities, but individually extremely minute and possessing little force. When such a wave comes in contact with a realtively massive body such as the diaphragm, which also, by reason of its elasticity and of its stiffness opposes being set in motion, there must be a considerable compression of the air wave before any motion can take place in the diaphragm, and when that motion does take place it will vary greatly in velocity and extent from the motions of the light and mobile air particles. The effect which the movement of this diaphragm has upon the magnet will then again be modified by the character of the diaphragm itself; that is, whether this diaphragm is itself a mass of iron or whether it simply carries an armature bodily or moves it by one end. All these things will have modifying effects, and therefore it is a matter of necessity that the form expressing electrical

changes must be a very different thing from the form expressing the air motions.

143 Int. Referring to the Bell Patent 174,465, I ask you if there is in the specifications of that patent suggested any other use, function or properties of Fig. 7, than as one of the ways or modes in which the armature C in Fig. 5 might be set in vibration?

A. None whatever.

144 Int. Would not the transmission of musical sounds by Fig. 7, be a complete performance of all the description and claims of Patent 174,465, in respect to it?

A. It would be.

145 Int. You have said, in answer to cross interrogatory 105, that an instrument complying with the claims of that patent (meaning Patent No. 174,465), absolutely would undoubtedly transmit speech. I ask you whether in your opinion there is anything contained in that patent which, to a person ordinarily skilled as an electrician, would indicate or show that that instrument would or would not transmit speech or was designed for the purpose of transmitting speech?

A. There is nothing whatever which would convey such information.

HENRY MORTON.

Counsel for complainant requests the counsel for defendants to permit him to take the models of the Bell Patent produced in evidence, stating that those very instruments will talk perfectly well if properly adjusted and operated, and that he desires to send them to the factory of the complainants in Boston, where they can be experimented with and where witnesses can examine them.

Counsel for the defendants says, that it would give him great pleasure to commit the custody of these instruments to counsel for complainant, as long as the counsel for the complainants will keep them, but he declines to have them travel to Boston or to the factory of the complainants, and if the complainants think they can make instruments to talk they would better indulge in a little manufacturing.

Counsel for complainants replies, that, although he knows perfectly well that he could make those instruments talk, yet

he does not propose to be a witness in this case, and he desires to submit them to his experts, who can testify.

HENRY MORTON.

Sworn to this 12th day of July, 1884, before me.

J. A. WELCH,
Special Examiner.

Adjourned to August 4, 1884.

J. A. WELCH,
Special Examiner.

Professor Morton, on the 22nd of July, 1884, pursuant to the request made by Mr. Dickerson in cross-interrogatory No. 118, furnishes the following translation from a work in German, entitled "Die magnet-und dynamo-elektrischen Maschinen;" by Dr. H. Schellen, Director of the Realschule at Cologne, Cologne, 1879, page 116, and revised edition of 1882, page 137:

"*Gramme machines for hand or foot power, Cabinet machines,* are built at the present time by the firm of Bróguet at Paris, a firm noted far beyond the limits of France, for the construction of instruments of precision of all kinds, and they are intended in part to replace, to a certain degree, batteries for medical purposes, and in part to furnish for instruction in Physics and Chemistry an apparatus at all times ready so as to produce at once, without any further preparation, a galvanic current of the strength of an eight cell Bunsen battery."

J. A. WELCH,
Special Examiner.

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29 WALL ST., NEW YORK,
August 4, 1884, 11 A. M.

Met pursuant to adjournment of July 12, 1884.

Present—Messrs. WHEELER H. PECKHAM and W. S. KNOX, for defendants; Mr. GEO. T. CURTIS, JR., for complainants.

FERNANDO E. WORCESTER, called and sworn as a witness on the part of the defendants:

Mr. Geo. T. Curtis, Jr., here states that he attends from Mr. Dickerson's office; that Mr. Dickerson is now in Newport, and that he knows from conversations with Mr. Dickerson that Mr. Dickerson did not understand that the examination of witnesses would proceed to-day; that a message was received from the office of Mr. Peckham, asking if the fourth of August would suit Mr. Dickerson, and an answer was sent saying that Mr. Dickerson was at Newport, and it certainly was understood at his office that the testimony would not go on to-day; that it is impossible to communicate with Mr. Dickerson and have him here at this sitting; that he is the only counsel in New York that knows anything about the case, and that he, Mr. Curtis, only attends as Mr. Dickerson's clerk for the purpose of requesting an adjournment of the present hearing for the reasons stated above, and he now requests the counsel for defendants to consent to such adjournment. Mr. Peckham says that at the last day of hearing the adjournment was fixed for this day, and it was definitely understood between him and Mr. Dickerson that if Mr. Dickerson, on going to his office, desired any other day, he would advise Mr. Peckham; that Mr. Peckham then told Mr. Dickerson that he desired to, and must, take the testimony of the witness, Mr. Worcester, from Buffalo, and that after that we would adjourn at Mr. Dickerson's convenience; that hearing nothing from Mr. Dickerson, about a week ago Mr. Peckham directed one of his clerks to inquire through the telephone of Mr. Dickerson's office whether he had any objection to the adjourned day, and was merely informed that Mr. Dickerson was in Newport; that hearing therefore no objection, Mr. Peckham obtained the attendance of the witness, Mr. Worcester, from Buffalo, at considerable expense, and conse-

quently must decline the request for an adjournment without taking his testimony.

Mr. Curtis states that the message received at Mr. Dickerson's office did not speak of the fourth of August as a day which had been already agreed upon, but rather as a day to be fixed upon if it would suit Mr. Dickerson, and that the person sending the message was informed that Mr. Dickerson was off on his yacht, and that he was probably at Newport, and it was certainly understood at Mr. Dickerson's office that nothing further would be done until Mr. Dickerson's return.

Mr. Curtis protests against the examination proceeding in Mr. Dickerson's absence, and requests that all rights of objection and of cross-examination be reserved with consent of defendants' counsel, if he still insists upon proceeding in Mr. Dickerson's absence.

Mr. Peckham consents that right of objection, except as to matters of form, may be reserved; also the right of cross-examination being reserved if complainants produce the witness, but declines to produce him.

Mr. Curtis objects to the testimony proceeding, and reserves all rights on Mr. Dickerson's behalf, and refuses to attend further on Mr. Dickerson's behalf.

The witness being interrogated by Mr. Peckham, testifies as follows:

1 Q. What is your name, age, residence and occupation?

A. My name is Fernando E. Worcester; my age is sixty-six; my residence is Buffalo, New York; my occupation is that of wood-engraver.

2 Q. Did you ever know Mr. Alfred G. Holcomb, and if so, when and where?

A. I knew him in New York, twenty-five years ago.

3 Q. At the time you knew him in New York, did you know of his being engaged with any electrical apparatus; and if so, when and where?

A. Yes, sir; I did. I knew him to be engaged with it in 1860, in Fifteenth street, New York.

4 Q. At the time to which you refer was Mr. Holcomb married?

A. No, sir; he was not.

5 Q. I hand you now Exhibit Holcomb Telephone, and I ask you whether you have ever seen that instrument or one substantially like it before, and if so, when and where?

A. I saw one just like that in his room in Fifteenth street, in 1860, in the fall of the year.

6 Q. I call your attention particularly to the tin cone on the exhibit, and I ask you to say whether the instrument you saw in 1860 had a tin cone substantially like that?

A. I did. I saw one exactly like that attached to the instrument.

7 Q. Now, Mr. Worcester, please state what you saw and heard and did in connection with that instrument, in respect to its operation, in 1860, and if you saw it in operation, state by whom it was operated, and what part, if any, you took in its operation?

A. The first time operated by Mr. Holcomb, and heard sounds from it, it counted ten, communicated from Mr. Holcomb from the back room. He had two machines and they were connected by two wires, one in the front room and one in the back room. The second time that I tested the machine was a short time after that. I don't know when. The second time Doctor Cornell operated on the machine, I heard indistinct sounds, communicating the word Boston. I don't know that I have anything further to state.

8 Q. How many times did you see the machine in operation all together?

A. Two or three times during the fall.

9 Q. Is Doctor Cornell dead?

A. Yes, sir.

10 Q. At the times of which you speak was your part in the operation that of listener only, or did you also talk?

A. I was a listener in all cases.

11 Q. When listening what did you do with the tin cone?

A. That was removed from the machine.

12 Q. Where did you put your ear?

A. Near the drum; what is called the drum. We called it the drum at the time.

13 Q. Please illustrate by the exhibit before you where you placed your ear?

A. I placed my ear as you now see me. (Witness takes off the tin cone, and lowers his head, placing one ear opposite the wooden diaphragm or box.)

14 Q. At the time of your operation with Dr. Cornell, did you

or he make any written memorandum of what he said and what you heard; and if so, did you make any comparison of such memorandum? Please state what you did, if anything, in that respect?

A. We operated on the machine for our amusement, one afternoon. He made communications and I listened in an adjoining room. The communication that I received was the word "Boston." I wrote it on a piece of paper. The doctor said that was correct, it was what he communicated.

15 Q. Had he anything written on any paper?

A. I think not.

16 Q. In 1860, did Mr. Holcomb explain to you, or state to you, anything about the purpose and object of the instrument; and if so, what did he say?

A. He said as soon as he got it perfect, he was going to get a patent on it—

17 Q. Did he say what it was for; and if so, what?

A. He said if he could get a patent, he wanted to sell it.

18 Q. I mean did he state to you what the instrument was designed to do, or what effect it was designed to produce; and if so, what?

A. He said nothing only he wanted to sell it; no conversation—

19 Q. Do you remember where Mr. Holcomb went, after he was married?

A. He told me he was going to Maryland.

20 Q. Did you see him in New York after he returned from Maryland?

A. I did.

21 Q. Can you tell us about what time that was?

A. I cannot.

22 Q. With reference to the war of the rebellion, can you tell what time it was with respect to that war?

A. Well, he was experimenting on the machine after the war broke out.

23 Q. Now, what I am asking you is, what time he came back from Maryland, with respect to the war?

A. It was during the war.

24 Q. Did he say anything to you as to what he had done with the instrument in Maryland; and if so, what did he say?

A. He told me that he had his machines there and experimented on them.

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25 Q. Did he say how they worked and what he had been able to do with them ; and if so, what did he say ?

A. He said he made wonderful improvements, and his wife could communicate with him on the place.

26 Q. In the experiments in which you took part, do you know whether there was any battery connected with the machine ?

A. There was none when he communicated with me. I mean Mr. Holcomb.

27 Q. How about when Dr. Cornell communicated with you ?

A. I don't know that the doctor applied the battery when he experimented.

FERDANDO E. WORCESTER.

Subscribed and sworn to this 4th day of August, 1884.

J. A. WELCH,
Special Examiner.

AUGUST 4, 1884.

Defendants' counsel put in evidence the following exhibits :

No. 75. British Letters Patent to John Henry Johnson, dated March 16, 1875, No. 974, for transmitting musical vibrations, with accompanying plates.

No. 76. Disclaims and Memorandum of Alteration of William Morgan-Brown, A. D. 1876, No. 4765, Electric Telephony and Telephonic Apparatus.

No. 77. Specification of David Edward Hughes, Telegraphic Apparatus, dated January 27, 1863, No. 241, with accompanying plates.

No. 78. Specification of Joseph Camp, Griffith Kennedy ; Electro-Magnetic Telegraphs, A. D. 1855, No. 2058, with accompanying plates.

No. 79. French Letters Patent entitled " Brevet Scott du 25 Mars, 1857, No. 31,470, et Certificat d'addition du 29 Juillet, 1859—Expedition."

Adjourned by consent of the counsel for the defendants, and of Mr. Curtis on behalf of Mr. Dickerson, the counsel for the complainants, to meet on notice or by consent.

J. A. WELCH,
Special Examiner.

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29 WALL ST., New York,
December 3d, 1884.

Parties met pursuant to agreement.

Present—MR. WHEELER H. PECKHAM and MR. W. S. KNOX, counsel for defendants; MR. E. N. DICKERSON and MR. GEO. T. CURTIS, JR., counsel for complainants.

The deposition of CARL H. A. BJERREGAARD, a witness sworn and examined on the part of the defendants:

EXAMINED BY MR. PECKHAM:

1 Q. What is your name, approximate age, residence and occupation?

A. My name is Carl H. A. Bjerregard. My residence is 2229 Fourth avenue, New York City. My age is about forty. My occupation is librarian of the Astor Library.

2 Q. Are you acquainted with the German language, and if so, please tell the Court what your acquirements therein are, what study you have given to it, and generally anything to show your capacity for accurate translation of German words or phrases into English?

A. I am familiar with the German language. I have been brought up in it as a child, and as a student of philology for about ten or fifteen years I have concerned myself with studying it in its general roots and construction comparatively; that is, under a full survey of the so-called Indo-Germanic languages or Indo-European, as they are called. From that follows that I am capable of determining the nature and linguistic value of any given word or term or phrase in German or English or any other of the allied languages. I am a Dane by birth and Danish in my native language, but born on the borders of Germany, we are brought up in both languages. In regard to English, I may say that I have been in this country eleven years and extensively engaged in lecturing in English, both publicly and privately, and in teaching; always extempore, without notes. I began to study English at school when a child in Denmark. When I arrived in this country I had not spoken English any more than in lessons in school; that was a basis for future study, having to handle the dictionary and grammar. Immediately after I came to this country I began to speak English habitually. At my house my wife and children speak only English.

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3 Q. Are you familiar with the German literature with respect to the discoveries and inventions of Philip Reis respecting the telephone?

A. I am familiar with the literature to that extent to which a librarian generally would be familiar with it, and if called upon I could by bibliographical dictionaries produce a survey or summary or list is the better term of the whole literature.

4 Q. I call your attention to the exhibit on page 537 of the Dolbear record, being the yearly report of the Physical Society at Frankfort-a-M., 1860–61, and also to the same exhibit on page 182 of the Spencer record, both purporting to be translations of the same German article, and calling your attention to the word "Tonsprache" in brackets on page 537 of the Dolbear record; I ask you to give the true meaning and translation of that word?

A. The word "Tonsprache" is a compound word and according to the fundamental laws of the German language, the emphasis lies upon "sprache," the latter part of the word; the first half "Ton" only being the defining component. Hence, in translating it, emphasis must be laid upon "speech," which is the translation of "Sprache." As for the first half of the compound word "Ton-Sprache," the word "Ton" may be translated either sound or tune; the word carrying both meanings.

The word "Tonsprache" means accordingly speech by sound of some kind or tune of some kind. It is speech by means of some medium, either simple sound or musical tune.

5 Q. In the connection in which the word seems to be used, please give the proper translation of the word in the Exhibit Dolbear Record before you?

A. The word cannot be literally translated to give a correct meaning, because the first half of the compound may mean both tune and sound in general. It will depend entirely upon the meaning of the whole way in which it is used, and upon the evident meaning of the speaker. In this case, as it was Reis's intention to construct an apparatus by means of which he could speak, the evident meaning of the word will have to be derived from the general aim and end of the apparatus. Modern philology would enquire into the actual use of the term, in order to decide its proper meaning, and would decide against any theory according to which the word would be translated either sound or tune.

6 Q. Have you read the original article of which these exhibits purport to be a translation?

A. I have made one translation from some article treating on Reis' instrument, but I cannot now give the name or date of it; to my recollection, it was an instrument by which he could speak. Judging from the illustrations I see here, I think it was another article.

7 Q. Was the word "Tonsprache" in common use prior to the use of it in that article by Reis?

A. I have not found the word either in Grimm's or Sander's German dictionaries, and judge that it was introduced by Reis.

CROSS-EXAMINATION BY MR. E. N. DICKERSON:

8 x-Q. When were you appointed librarian of the Astor Library and who was your predecessor?

A. In the year 1879. I had no predecessor. My department being a new one just established. I am not assistant librarian, but librarian. According to the minutes and by-laws of the library there are four librarians each with his assistants.

9 x-Q. What is your department?

A. Classification and purchase of new books.

10 x-Q. Is there no superior librarian in that library?

A. There not; there is a superintendent. Each of the four librarians are responsible to the Board of Trustees. The general supposition is that Mr. Saunders is the librarian. He is so in name. He is, however, only one of four. It is so explicitly stated in the years report 1881 or 1882.

11 x-Q. Then there is no superior in the library itself, either under the title of superintendent or librarian; is that so?

A. The superior officer is the superintendent; under him rank the four librarians.

12 x-Q. What is the name of that superior under whom the librarians perform their duties?

A. His name is Robbins Little.

13 x-Q. Do you understand that the word "Tonsprache" in the original article means articulate speech; and if so, give the German synonym of "Tonsprache," which signifies articulate speech?

A. The word does not mean articulate speech. It means speech by some medium or other, sound in general or musical tune, or any other medium. The German word for articulate speech is simply "Sprache."

14 x-Q. Do you think that if a German were describing speech

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transmitted through the speaking tubes of a house he would call it "Tonsprache?"

A. There would be no need of using another term; his speech or speaking through the speaking tube being not essentially modified.

15 x-Q. Do you think that the speech that is usually transmitted through an ordinary Bell telephone is so modified as that the requirement of the German language would give to it the name of "Tonsprache," in order to distinguish it from "Sprache" or articulate speech?

A. I do not know the telephone sufficiently to give an answer to he question.

16 x-Q. Have you ever listened through a telephone through which a person was talking to you?

A. I have some years ago, at the American Institute Fair; but I do not know the name of the instrument, nor have I distinct impressions of the nature of the sounds.

17 x-Q. Supposing those sounds to be a substantial reproduction of the voice of the speaker, so that you could recognize the peculiarities of his voice and understand what he said, do you think, if you were a German, you would call that kind of talk "Tonsprache?"

A. I might; I might not. If I were an intelligent German, I would inquire into the actual use of the term before using it myself.

18 x-Q. Don't you think the prefix of the word "Ton" qualifies the word "Sprache?"

A. It does; but it is not the main word in the compound "Tonsprache." It is simply the defining compound, and "Sprache" is the main word.

19 x-Q. And doesn't it qualify the word "Sprache," which means articulate speech, so that the compounding of the word makes it mean something different from articulate speech?

A. It does qualify it, but as it itself carries different meanings, I cannot determine which quality it gives to articulate speech, or to "Sprache," the main word. The word articulate should be struck out.

20 x-Q. Then you mean to say, do you, that "Sprache" in German doesn't mean articulate speech?

Objected to by defendant's counsel, on the ground that the witness had not said nor intimated anything of the kind.

A. I wished the word articulate struck out because I think I didn't say articulate, but simply speech.

21 x-Q. Same question repeated.

A. I do not. "Sprache" means articulate speech, as I said before.

22 x-Q. Does it mean anything but articulate speech; by which I mean intelligent speech by human beings?

A. No; it does not.

23 x-Q. Then give the different meanings which you say the prefix "Ton" has, in order that the Court may be able to select that one which you may say belongs to the word "Sprache" in this connection?

A. The word "Ton" means sound, tone and tune, in the various ways in which those three words are used.

24 x-Q. Then it must qualify the word "Sprache" in one of three ways, either in speech by sound, or speech by tone or speech by tune; is that so?

A. It does.

25 x-Q. In German, when the sound of articulate speech is referred to, it is expressed by the word "Laut," is it not, as distinguished from the word "Ton"?

A. That is not quite correct. Laut means any sound.

26 x-Q. Will you give me the correct German expression for "the sound of the speaker's voice?"

A. Laut der stimme des sprechenden.

27 x-Q. Will you give the correct German expression for the sentence "The sound of a bell was heard at a distance?"

A. Laut der glocke von ferne gehort.

28 x-Q. Then in German the word "laut" is properly applicable as well to the human voice as to the sounds of musical instruments or a bell, and the word "Ton" is not more appropriate to express the sound of a bell or a musical instrument?

A. Both terms may be used. It depends on what you want to express. The mere mechanical effect would best be expressed by laut, while the musical effect by ton.

29 x-Q. In view of this correct definition, don't you think the word "Tonsprache" implies a musical effect?

A. On its face it might, but to get at its true meaning we must know its actual use.

30 x-Q. Then, as a person understanding the German language, you are unable to tell the Court what the meaning of the word "Ton-

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sprache" is, unless you know something more than what the word itself presents to you?"

A. I am unable to tell, and any and all philologists would be unable to tell its meaning from a mere examination of the word, except as far as defined already, being speech by some medium or other.

31 x-Q. Then, the prefix "Ton" means, to your mind; only "some meaning or other," when combined with the word "Sprache?"

A. It does. It is simply the defining component.

32 x-Q. Do you think that to be a defining component that gives no other definition than "by some means or other?"

A. It gives a definition, as I said before, three definitions being mentioned before.

33 x-Q. Will you explain to the Court what you would understand to be the meaning of "Tonsprache," when you translate "Ton" into sound, and make it speech by sound?

A. If I translate the word "Ton" sound, then I would translate the word sound-speaker; but if I translate it by tone, I translate it tone-speaker; and if I translate it by tune, I translate it tune-speaker.

34 x-Q. Are you acquainted with any variety of speaking which isn't sound-speaking; and, if so, mention it?

A. All audible speech necessarily uses sound as a medium.

35 x-Q. Don't you think that if the object of the writer was to express merely articulate speaking it would be somewhat superfluous to say it was done by sound?

A. I do not know what his object was. I have not read his essay.

36 x-Q. (Question repeated.)

A. No, I don't know why it should be. A scientific man is very explicit. Still, I don't understand the question fully.

37 x-Q. If, on the other hand, it was the object of the writer to express an operation in which singing was to be done, don't you think that the prefix "Ton" would be appropriate?

A. In that case he might have used the term "Musik-sprache," or "Gesang-sprache," which would be good German.

38 x-Q. But you think it wouldn't be good German to say "Tonsprache?"

A. It would be good German, but not explicit.

39 x-Q. Now, if you found in that article this statement, "Now, in reference to the capabilities of the telephone, it may be stated

that I was enabled to render audible to the members of a large assembly, the Physical Society, at Frankfort-a-M., melodies that were sung not very loud into the apparatus, in another house three hundred feet away, with closed doors," would you say that the expression "Tonsprache" was an appropriate word to be applied to that performance?

The witness is handed, by the counsel for the complainants, the German original of which the extract read is a translation.

A. It would be an appropriate word to apply, but that would not give the general sense in the translation. In glancing over the essay before me, and recollecting another essay by Reis on a similar subject which I have read, his main purpose seems to have been to transmit sound, simply, of some kind or other.

RE-DIRECT BY MR. PECKHAM:

40 Re-d. Q. Is there a stream in German Switzerland known as "Lauterbrunnen"?

A. There is.

41 Re-d. Q. Please translate the word "Lauterbrunnen"?

A. I do not know the etymology of the word, but I can translate it literally. The word "Brunnen," the main word, means springs, wells, fountains or anything of that kind, and the word "Lauter" means only, "Nothing but"; hence the word "Lauterbrunnen" would mean "nothing but springs," or wells, &c.

42 Re-d. Q. Assuming that a telephone is an instrument by which speaking against a diaphragm causes electrical action at a distant station, which electrical action in its turn causes sounds similar to the sound of the word spoken, which are heard by the listener; the listener, however, hearing not the sounds spoken by the speaker, but the similar sounds produced by the electrical action; I ask whether the word "Tonsprache" would be an appropriate German word to describe what was heard by the listener?

A. I should think it wasn't, and that Reis simply chose a word that came nearest to hand, to express his object, and without considering the linguistic properties of it.

43 Re-d. Q. You say you should think it was not. Why not?

A. Because it is too indefinite.

44 Re-d. Q. Now, suppose that in the essay, or the exhibit that has been referred to, you found this statement, "Hitherto it has not been possible to reproduce human speech with a distinctness sufficient for every one; the consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree;" would you say that the expression "Tonsprache" was an appropiate word to be applied to that performance?

A. I would say it is, because Reis has in view the power attained to at that time to transmit human speech, and hearing him pronounce the word we should hear him emphasize very strongly "Sprache."

45 Re-x-Q. Did you mean to say that Reis had at that time an apparatus capable practically of transmitting human speech?

A. From the passage read to me I understood that he had attained to that.

46 Re-x-Q. Now look at the original German and say whether the words "dei Tonsprache des Henschen," and say whether those words are correctly translated by the English words "human speech" as given in the translation read to you in question 44?

A. It is no literal translation. It seems in this case that the words were used in a certain accepted sense different from the first use of it, and I should judge that he intended to say human speech, though, as I said, it is no literal translation.

47 Re-x-Q. Give me the literal translation of those words in the German original?

A. If I am to translate it literally, I should translate it, human sound speech, or tone speech, or tune speech, either one of the three being correct literally.

48 Re-x-Q. Wouldn't it be a proper translation to say, "the tones of human speech?"

A. It would be no more proper than to say the sound of human speech or the tune of human speech.

49 Re-x-Q. If it was meant to express the fact that human speech was transmitted, without any qualification whatever, do you think that the expression "Tonsprache des Henschen" would be the proper one?

A. I said before, it appears evident that the word "Tonsprache" here in this place is used in a certain accepted sense and it would seem to me that by it he meant to express human speech—as by reference to the following paragraph my statement seems to be

proved where Reis speaks about the experiments of Willis, Helmholtz and others to reproduce vocal sounds; I meant vocal sounds.

50 Re-x-Q. And you infer, do you, that because Reis referred to Helmholtz's experiments for producing vocal tones artificially, therefore in the passage which you have translated he meant by the word "Tonsprache," merely "Sprache" without qualification, and attached no meaning whatever to the prefix "Ton?"

A. I mean to say that in the present instance Reis is discussing the question of transmitting human speech, and that that is evident from the fact that he speaks about reproduction of consonants and vowels, which in all probability he would not do if he were not discussing the question of reproducing human speech.

51 Re-x-Q. Won't you answer the question, which is this: Is it your opinion that in the paragraph quoted the prefix "Ton" is merely surplusage, and not intended to qualify the word "Sprache" with which it is associated?

A. I said before, in the present instance the word is evidently used in a certain accepted sense; and it does seem that that sense is human speech.

52 Re-x-Q. In the second paragraph it is thus written "a reproduction of tones ('Tonen') at certain distances by means of a galvanic current has probably been thought of." Do you translate the word "Tonen" into the English "articulate speech," in that paragraph?

A. I see no reason for translating it thus.

53. Re-x-Q. Will you give the translation which you deem the correct translation?

A. The word ought to be translated *sound* or *tone*, possibly *tune*.

54. Rex-Q. In the same article the following sentence is found: "At the first condensation the hammer-like wire *d* is pushed back; at the rarefaction it cannot follow the retreating membrane, and the current traversing the strips remains broken (Strombleibt so lange unterbrochen bis, *etc*), until the membrane forced by a new condensation again presses the strip (proceeding from *p*) against *d*."

Is the German word "unterbrochen" properly translated by the English words *broken* or *interrupted*?

A. It is unnecessary to say *broken;* it is *interrupted*. I hardly see why it is necessary to say broken and interrupted. It would be sufficient to say "interrupted."

55. Re-x-Q. Does the German word "Zerbrechen" properly

express breaking or interruption of the electric current, and if not, give the true meaning of that German word?

A. It does not. The primary meaning is to break to pieces, to ruin, while "unterbrochen" means to interrupt, and that is probably the only word used in connection with telegraphy or electricity. I hardly see how the other could be used.

C. H. A. BJERREGAARD.

Subscribed and sworn to before me this 3d day of December, 1884.

JOSEPH A. WELCH,
Special Examiner.

Defendants' counsel put in evidence "Yearly Report of the Physical Society at Frankfort, a-M., 1860–1861, pp. 57–64 (published in 1862)," as the same is printed in the printed record in the case of American Bell Telephone Company vs. Albert Spencer *et al.*, on pages 182–189 inclusive, and as there entitled, with the plates.

Defendants' counsel put in evidence "A Lecture entitled Researches in Electric Telephony, by Professor Alexander Graham Bell, delivered before the Society of Telegraph Engineers, October 31st, 1877," published at London and at New York by F. and F. N. Spon, in 1878, with the plates.

Defendants' counsel put in evidence an original article in the German language, contained in the "Yearly Report of the Physical Society at Frankfort, a-M., 1860–1861," on pages 57 to 64 inclusive thereof, entitled "Ueber Telephonic durch den galvanischen strom von Philipp Reis," with the accompanying plates.

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29 Wall Street, New York, December 3d, 1884.

Deposition of GEORGE W. BEARDSLEE, a witness sworn and examined on the part of the defendants.

EXAMINED BY MR. PECKHAM:

1 Q. What is your name, age, residence and occupation?

A. My name is George W. Beardslee; my age is seventy-two years last March; I reside at 314 Greene avenue, Brooklyn, N. Y. my occupation is that of electrician, electrical engineer.

2 Q. Did you know one Dr. Bradley, and also a Mr. Holcomb, in the years between 1860 and 1870; and, if so, please tell us when and where you knew them, and the extent of your acquaintance?

A. I knew Dr. Bradley from 1860 to 1863 or 1864, during which period I had business relations with him, and during that time he introduced to me Mr. Holcomb, at my works at College Point, Long Island.

3 Q. Calling your attention to Exhibit Holcomb Telephone now before you, I ask whether at the time to which you refer in your preceding answer, Dr. Bradley or Mr. Holcomb had any machine or device, and if so, if they or either of them explained to you its uses or purposes; if so, please describe what kind of instrument or device they had, and what they or either of them said with respect to its uses or purposes?

A. In the early part of my acquaintance with Dr. Bradley, he brought up to my place of business a telegraphic instrument which, I think, he denominated his "sounding relay," which instrument I now have at College Point, stored with my other machinery there. During these interviews he spoke to me of a friend, or of an acquaintance he had, who had made or was making an instrument or instruments for the purpose of conveying sounds or words at a distance. He also stated that the instrument was organized with a very peculiarly formed magnet, and that he had great difficulty in shaping the magnet out of steel; that during these interviews he had learned that I was making very permanent magnets, by a process I had discovered, out of cast iron, and that his friend would like to have his magnets made by the same process, and stated that he would have his friend come up to see me. He brought his friend there, Mr. Holcomb, who had an instrument like the exhibit referred to, in which I saw the peculiar configuration of the magnet, the same as in the exhibit, with a pair of electro-magnets connected with their poles, with an armature which was acted upon by a diaphragm, similar to that shown in the exhibit referred to; the diaphragm and armature were made adjustable. In the place of the hoop shown in the exhibit there was a bowl-shaped piece placed, expanding at the outer edge. He claimed that by the use of such instruments he could communicate sounds and words at a distance through an electric circuit.

His explanations and the conversation that occurred at that time impressed me at that time from the fact that I had seen a similar instrument some years prior amongst the apparatus con-

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structed by Doctor Charles G. Page, of Washington, which then was a novel instrument to me. I put the question to Dr. Page to know what he did with such an instrument; his answer was: "I talk with it, it is my talking machine." That is the way he expressed himself.

4 Q. I want you to fix as definitely as possible the time of this conversation with Mr. Holcomb, and give your reasons for so fixing the time?

A. My business relations with Dr. Bradley ceased some time in 1863, and these interviews must have been prior to that. I think it was in 1861 or 1862, certainly not later than 1863.

5 Q. If you remember any more details as to what was said by Mr. Holcomb or Dr. Bradley with reference to the purpose of the instrument or its capacity in the transmission of speech, please give them?

A. There was a discussion occurred at the time about these instruments. I expressed a desire to understand how and in what manner he proposed to make this communication at a distance; he being an electrician as well as myself, says: "You understand, undoubtedly, that any variation of the distance of the armature from the poles of the magnet would induce, or does induce, a current of electricity in the wire of the spools connected with the poles of the magnets." He explained to me that the vibrations of the diaphragm in connection with the armature would produce the variations of distance spoken of, thus obtaining a current of electricity, and that the current itself being variable, thus produced, would produce corresponding vibrations, if another instrument placed at a remote point in a circuit.

Adjourned till December 4th, 1884, at 11 A. M.

J. A. W.
Special Examiner.

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29 WALL ST., NEW YORK, Dec. 4, 1884, 11 A. M.

Present—MR. PECKHAM and MR. KNOX, Counsel for Defendants; MR. DICKERSON and MR. CURTIS, Counsel for Complainants.

Deposition of GEORGE W. BEARDSLEE, resumed:

CROSS-EXAMINED BY MR. DICKERSON:

5 x-Q. You say that Dr. Bradley introduced Mr. Holcomb to you "at your works at College Point, Long Island." Describe your works at College Point, Long Island, where they are situated, what business was carried on at your works and who were your employees engaged in the work therein?

A. I made an arrangement October, 1858, with Charles M. Keller, who had been my attorney, to go to College Point for the purpose of forming a business connection with Conrad Poppenhousen, for the purpose of developing the manufacture, and operating machines and other matters connected with improvements that I had made in the production of the electric current and its uses, and a business arrangement was formed in pursuance of that conversation, and a company was formed, called the "Beardslee's Magneto-Electric Company." Each party, Mr. Poppenhousen, Mr. Keller and myself, were joint owners in that company; our business was the construction of machines and batteries for the purposes of producing the electric current, and the use of such currents for the production of electric light, electro metalurgy, electro deposition of metals, for telegraphs, torpedo operations and uses, and for all the purposes for which electric currents were then known and used. The men were employed by the company, myself receiving a salary. I would add to that answer that my works at first were in the rubber factory of Poppenhousen, the first year; and the next year a place was fitted up remote from the factory about five hundred feet, in a building that had been occupied as a dwelling, in which was placed a steam engine and a foundry built in addition. At this factory—we called it factory—all my interviews with Dr. Bradley and Mr. Holcomb took place. We coated with metal, by means of the electric current, and metallic both, with silver, copper and other metals, nickel, and extensively combs, rubber combs, and other articles of rubber manufacture, hard rubber. We also made large depositions of copper by making electrotypes. During those operations of electrotyping a

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gentleman of the name of L. L. Smith, an electrotyper of New York, used our machines for the purpose of electrotyping.

6 x-Q. What machinery did you have in your works, when they were in the dwelling house you spoke of?

A. We had all the machinery used ordinarily in a machine shop, and also a great variety of electric current producing machines which had been manufactured by us, and also the requisite machinery to carry on a foundry.

7 x-Q. Enumerate as nearly as you can the machinery which you had in this dwelling house which constituted the works of this Electric Company?

A. We had engine laths, drills, boring machines, planers, grindstones, circular saws, buffing machines, emory wheels; we also had in operation a great variety of current producing machines, blower in the foundry, and a twenty horse-power engine, and also a one horse-power engine.

8 x-Q. What year was it that you saw Holcomb at College Point?

A. Between the years '60 and '63.

9 x-Q. Can't you fix it any nearer than that?

A. I cannot.

10 x-Q. Did he say anything about a patent on the subject matter about which he talked to you?

A. I don't remember that he did.

11 x-Q. Did he talk to you about the shape of the magnet in the shaping of which he had great difficulty?

A. He did.

12 x-Q. Look at the letters patent No. 32,478, dated June 4th, 1861, and say whether the magnet shown in the drawing of that patent is the one about which he talked to you?

A. The form, configuration is the same; but the one I saw, the heel was longer in proportion to the projecting poles.

13 x-Q. Was the machine that he showed you similar to the one shown in that patent?

A. It bore some resemblance to this, but was not a relay, as this evidently is. The armature was divided; it opened and closed by the vibratory action of the diaphragm.

14 x-Q. Dr. Page was a gentleman of considerable scientific reputation and a discoverer in the early history of discovery of electrical apparatus, whose contributions to scientific literature on that subject were well known; wasn't he?

A. He was pre-eminently so, and communicated to the public, as a general rule, perfected discoveries that he made.

15 x-Q. Did he communicate to you, when he showed his electrical telephone several years before 1860, either confidentially or otherwise, why he hadn't published to the world that he had a talking electrical telephone in the Patent Office at Washington? Or, did he tell you that he had made that publication and it had perished?

A. He did not.

16 x-Q. Haven't you claimed, at some time, that you were the inventor of the electric talking telephone, before the date of Bell's patent?

A. I have no recollection of making any such claim. The first knowledge I ever had of the device was from Dr. Page and from Mr. Holcomb. I will add to that answer that I did make something that might be called a telephone, a hollow cup; stretched a diaphragm of bladder on one end, and attached a string to connect the two together from the centre of the diaphragm, with which we held a conversation together at a distance. This was prior to 1860; I cannot give the year.

17 x-Q. Did you mention to Holcomb that the electric telephone similar to the one he had was well known to you, having seen it in Dr. Page's possession?

A. I have no recollection of doing so; but I might have done it; might have made the remark.

18 x-Q. At any rate, when Mr. Holcomb showed you his machine and told you what he had done, it was not a matter of surprise to you that a man should have an electric telephone, having already seen it several years before. Is that so?

A. I don't think he had told me what it had done, but what it could do, I think was his expression, or what it had done. He seemed to be a little secretive about it, as if he didn't want to let me know too much. I will add to that answer, that I drew my own conclusions with regard to what it could do, on examining the machine.

19 x-Q. When Bell's telephone became public in 1876, did it strike you as a matter of surprise or novelty, or as a thing that you were familiar with since you saw Dr. Page's telephone?

A. I have no recollection of seeing such a publication at the time named, nor have I any recollection of ever having seen either

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a Bell telephone or a description of the telephone, until it was brought out by the recent trial.

20 x-Q. Where were you living from 1876 to 1884?

A. The same place I now reside, 314 Greene avenue, Brooklyn.

21 x-Q. Being an electrical engineer, as you say you are, how do you acoount for the fact that during all those years you had no knowledge respecting the Bell telephone?

A. Well, I was partly engaged in other pursuits, involving electrical developments and the use of the electrical current. I took but little interest in developments of that nature, but did go to see Edison's phonograph, from the fact I had read an account in 1863 of a similar instrument, or I suppose to be similar, made by M. Scott, of Paris, France, which I made an attempt to investigate while in Paris in 1866.

22 x-Q. Did you find them to be similar?

A. I did not succeed in my investigations. Mr. Scott was then absent from Paris, but I subsequently learned that his process simply recorded signs, I think, upon a smoked glass, made by the vibrations of the diaphragm; which vibrations were made by the human voice or other sounds; while the Edison instrument made indentations upon foil.

23 x-Q. And, so far as you know, that is substantially the difference between the two things?

A. Not entirely. The sounds could not be reproduced by Mr. Scott's process, while they were by Edison's.

24 x-Q. When you did hear of the Bell telephone, did it strike you as anything very remarkable, in view of Dr. Page's telephone?

A. It did not, from the fact that I had myself made, immediately following my interview with Holcomb, several organizations to test to my own satisfaction whether Holcomb was correct or not in the claims which he had made for his instrument. I made a pair of instruments which I now have on hand, which demonstrated that the human voice could be conveyed by the means pointed out by him, which was a little more effectual for short distances which I tried them, than the bladder diaphragms I had made and used before; but I saw nothing in the use of them, so far as I tested them, that that would demonstrate the construction of such instruments, to operate at great distances, and therefore regarded them as a mere toy.

RE-DIRECT BY MR. PECKHAM:

25 Re-d. Q. You say you now have instruments you made after your interview with Mr. Holcomb; have you them here with you?

A. I have one of the pairs which I then made here with me.

26 Re-d. Q. Please produce it and let us see it?

A. I now so produce it.

27 Re-d. Q. Please describe the instrument, its several parts and mode of operation?

A. The instrument contains permanent magnets as in the Holcomb machine. This permanent magnet is formed by seven rings of cast iron prepared to retain magnetism and charged on their opposite sides with opposing poles. On one of the poles is mounted a very fine open wire spool, made by Bradley; over the spool, in an iron frame, is a thin diaphragm of iron, with a chamber and a mouth-piece above it; the opposite pole from that upon which the spool is mounted is connected with a diaphragm through the iron adjusting screw, the opposite adjusting screw being of brass, or non-magnetic substance. These adjusting screws performed the function, as shown in the Holcomb instrument, to regulate the distance of the diagram from the pole of the spool. The call in this instrument, as now exhibited, is made by a ratchet wheel, revolved by a crank, which operates upon a steel spring firmly fixed to the diaphragm. This device was not shown in the Holcomb's machine, but was put into this instrument by me some eight or nine years ago. Prior to that I had used what is called a toot-horn to make a call. I think, at the same time, I replaced the diaphragm, which had become rusted out.

28 Re-d. Q. When did you make that instrument, as it now stands, except the device for a call, and except the replacing of the diaphragm?

A. Subsequent to my interview with Mr. Holcomb, and prior to 1865. I can't fix the precise date. I went to Europe in 1865, in July.

29 Re-d. Q. I understood you to say that that instrument is one of a pair made at the same time. If I am correct, please state whether you used the pair with which to communicate, and if so, how they were connected, where they were respectively placed, and with what results?

A. I omitted in my description two binding screws which are connected with the terminals of the spools. I have at my house the

a Bell telephone or a description of the telephone, until it was brought out by the recent trial.

20 x-Q. Where were you living from 1876 to 1884?

A. The same place I now reside, 314 Greene avenue, Brooklyn.

21 x-Q. Being an electrical engineer, as you say you are, how do you acoount for the fact that during all those years you had no knowledge respecting the Bell telephone?

A. Well, I was partly engaged in other pursuits, involving electrical developments and the use of the electrical current. I took but little interest in developments of that nature, but did go to see Edison's phonograph, from the fact I had read an account in 1863 of a similar instrument, or I suppose to be similar, made by M. Scott, of Paris, France, which I made an attempt to investigate while in Paris in 1866.

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23 x-Q. And, so far as you know, that is substantially the difference between the two things?

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RE-DIRECT BY MR. PECKHAM :

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A. I now so produce it.

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29 Re-d. Q. I understood you to say that that instrument is one of a pair made at the same time. If I am correct, please state whether you used the pair with which to communicate, and if so, how they were connected, where they were respectively placed, and with what results ?

A. I omitted in my description two binding screws which are connected with the terminals of the spools. I have at my house the

mate of this instrument made in the precise manner that this is. I have had them connected together by wires, not exceeding, however, more than about a hundred feet apart, through which calls were made and conversation carried on, which was a little more distinct than by the bladder diaphragm instruments I have before named.

30 Re-d. Q. When did you have such conversation with the pair connected together, and where?

A. At my house in College Point, prior to 1865, and since at my house, 314 Greene avenue, Brooklyn. I have not, however, had them connected for the last five or six years, at all.

The testimony of the witness on this subject is objected to, as not being in issue on this case.

31 Re-d. Q. Please state whether the operation of those instruments was by means of electrical currents, or otherwise?

A. The vibrations of the diaphragm to and from the pole of a permanent magnet, as organized in this machine, induces in the insulated wire of the spool, Faradayic or induced impulses of electricity. The operation was by electrical currents.

The said instrument produced by the witness offered in evidence by defendants' counsel and marked "Exhibit Beardslees' Holcomb Telephone," J. A. W., Special Examiner December 4th, 1884.

Same objection by complainants' counsel.

GEO. W. BEARDSLEE.

Subscribed and sworn to before me this 4th day of December, 1884.

JOSEPH A. WELCH,
Special Examiner.

The deposition of MARY W. FITCH, a witness called and sworn on the part of the defendants.

EXAMINED BY MR. PECKHAM:

1 Q. What is your name, age, residence and occupation?

A. My name is Mary W. Fitch; residence, Farmingdale, Long Island; my age is forty-three. I have no special occupation.

2 Q. You are married?

A. Yes, sir; my husband is still living.

3 Q. Did you know Dr. Bradley in his lifetime?

A. Yes, sir.

4 Q. What was his full name? also, give the date of his death, as near as you can.

A. His name was Loveritt Bradley. I cannot give the exact date of his death; I think it was in 1874, but I am not sure.

5 Q. Please state whether he was any connection of yours, and when and how long and under what circumstances you knew him.

A. He was my step-father, and he came to board with my mother, I think, in 1860, and I knew him well until he died.

6 Q. When did he marry your mother?

A. About 1867, I think.

7 Q. Did you ever hear Dr. Bradley speak of a Mr. Holcomb?

A. I did.

8 Q. Please state when and where it was and what he said.

Objected to as not competent evidence.

A. As near as I can remember it was in the fall of 1860 or spring of 1861, soon after we moved to Jersey City, where he had his shop. He spoke of a Mr. Holcomb making or inventing a talking instrument or talking machine, and seemed very much elated.

9 Q. What kind of a shop?

A. For making electrical instruments; naked wire for magnets for telegraph instruments.

10 Q. How do you fix the time when you heard this conversation of Dr. Bradley?

A. I remember the room that I was in at the time that I heard him speak of it; it was a room we had used for a kitchen; some months after we moved there we had a room partitioned off one end of it, and it was before that room was built. The man that had the

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lower floor was a furniture dealer, and at the time of which I speak had furniture stored in that room. It had to be removed for our room to be built, which was done very soon after we moved there; within a few months. I remember the furniture was in that room at the time this conversation took place.

11 Q. What was the date of your marriage?

A. April 3d, 1864.

12 Q. After your marriage did you continue to live at home, or did you move elsewhere?

A. I lived home two years.

13 Q. Can you tell whether this conversation occurred after you were married, or before?

A. Several years before—a year or two before; I can't remember exactly, because I have had a great deal of trouble, and all these things have passed out of my mind; it was recalled by a chance conversation or I should not have thought of it again.

CROSS-EXAMINED BY MR. DICKERSON:

14 x-Q. What was Dr. Bradley's profession?

A. He was an inventor.

15 x-Q. Didn't he have any regular business?

A. Nothing more than making up the telegraph instruments upon which were used these naked wire magnets, which were his invention.

16 x-Q. In what year did you move to Jersey City?

A. 1860.

17 x-Q. Between whom was this conversation that you now remember?

A. Dr. Bradley and my mother and myself.

18 x-Q. State exactly what Dr. Bradley said and what your mother said and what you said, as near as you can remember?

A. I don't remember saying anything myself, or of hearing my mother say anything. I remember the doctor saying he had seen a talking machine, and could hear words distinctly; that it was a grand thing, and he thought it would be a perfect success. That is about all I remember.

19 x-Q. Didn't he mention the name of any one as having invented it?

A. He mentioned Mr. Holcomb.

20 x-Q. Were you acquainted with Mr. Holcomb at that time?

A. No, sir; I never saw him.

21 x-Q. You said that Dr. Bradley seemed very much elated during that conversation. Will you describe to the Court his appearance, which led you to make that remark, and what Dr. Bradley did that showed that he was very much elated?

A. I remember he walked up and down the room while talking, rubbing his hands and talking very fast.

22 x-Q. About how long did he continue rubbing his hands and walking up and down the room and talking very fast?

A. I don't remember.

23 x-Q. You have told us that he said about twenty words. Did he say any more when he was talking very fast and walking up and down the room, rubbing his hands?

A. I don't remember anything more.

24 x-Q. Do you remember any other conversation of his twenty-four years ago, on that occasion or near that time?

A. No, sir; I do not.

25 x-Q. After this had all passed out of your mind, whose chance conversation was it that recalled it to you, and when and where was that?

A. Conversation with my husband at our house in Farmingdale last summer

26 x-Q. Who is your husband, and what is his occupation?

A. Frederick K. Fitch, maker and repairer of telegraph instruments.

27 x-Q. Where is his place of business?

A. No. 40 Cortlandt street.

28 x-Q. What does he have to do with telephones?

A. I do not know.

29 x-Q. Does he manufacture electrical apparatus himself, or is he in the employ of others?

A. He manufactures them himself.

30 x-Q. Who was present at this chance conversation besides your husband and yourself?

A. My husband's brother, David Fitch.

31 x-Q. Now repeat the conversation as it occurred, and what each one said?

A. My husband asked me if I remembered hearing Dr. Bradley ever speak of Mr. Holcomb; I told him I did; he asked me if I heard him speak of a talking machine, an invention of Mr. Holcomb's; I

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said I did, but had forgotten it until the name Holcomb recalled it; he asked me if I ever saw Mr. Holcomb; I said I did not; he asked me if I remembered at what time I heard the Doctor speak of this machine; I told him, soon after we moved to Jersey City—as near as I could remember, the fall of 1860 or spring of 1861; he told me of a lawsuit, between whom I can't remember, and I thought no more about it until I saw Mr. Gannon.

32 x-Q. Did he tell you how he was interested in that lawsuit?

A. No, sir.

33 x-Q. In what business is your husband's brother David?

A. He is out of employment.

34 x-Q. What is his business when he in employment?

A. Clerk.

MARY W. FITCH.

Subscribed and sworn to before me this 4th day of December, 1884.

JOSEPH A. WELCH,
Special Examiner.

Defendants rest, reserving the right to prove certain experiments now being made by Prof. Brackett and assistants, and also to put in the depositions of certain foreign witnesses, respecting which a stipulation is to be made by Mr. Peckham and Mr. Dickerson.

December 4th, 1884.

JOSEPH A. WELCH,
Special Examiner.

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At a Stated Term of the Circuit Court of the United States, held at the Post Office Building, in and for the Southern District of New York, on the 7th day of October, 1884.

Present—HON. WILLIAM J. WALLACE, Judge.

AMERICAN BELL TELEPHONE COMPANY ET AL.,
Complainants,

AGAINST

THE MOLECULAR TELEPHONE COMPANY, and others,
Defendants.

This cause having come on to be heard on a motion by defendants, duly noticed, for Commissions, after hearing the counsel for the respective parties, and due deliberation having been had thereon, on motion of Miller, Peckham & Dixon, solicitors for defendants, it is ordered, that commissions issue in this action out of and under the seal of this Court, one thereof directed to Lorin A. Lathrop, Esq., United States Consul at Bristol, England, to examine under oath, upon interrogatories to be annexed thereto, Thomas Ballard, of Bristol, England, Stephen M. Yeates, William Rigby, John Rigby, A. M. Vereker and Dr. William Frazer of Dublin, Ireland; and the other thereof directed to Ferdinand Vogeler, Esq., United States Consul at Frankfort, Germany, to examine under oath, upon interrogatories to be annexed thereto; Dr. F. Ehren and Dr. Thomas Stein, of Frankfort, Germany, witnesses on behalf of the defendants, in both which complainants will be at liberty to join.

Ordered, that complainants have ten days after notice of the filing of defendants' interrogatories within which to file cross-interrogatories; and that, upon the filing of said cross-interrogatories within said ten days, or in default thereof, that said commissions issue.

WM. J. WALLACE.

[ENDORSED:]

U. S. Circuit Court, Southern District, of New York. American Bell Telephone Company *et al.*, vs. The Molecular Telephone Com-

pany and others. Order for Commissions. Miller, Peckham & Dixon, solicitors for defendants, 29 Wall Street, New York. United States Circuit Court. Filed October 7th, 1884. Timothy Griffith, Clerk.

(A copy.)
TIMOTHY GRIFFITH,
Clerk.

[SEAL.]

UNITED STATES CIRCUIT COURT.

THE AMERICAN BELL TELEPHONE COMPANY ET AL.

AGAINST

THE MOLECULAR TELEPHONE COMPANY and others.

It is hereby stipulated that the interrogatories and cross-interrogatories, and the respective answers thereto, administered to and answered by the witnesses Thomas Ballard, of Bristol, England; William Frazer, of Dublin, Ireland; Stephen M. Yeates, of Dublin, Ireland; A. M. Vereker, of Dublin, Ireland; John Ehren, of Frankfort-on-the-Main, Germany; Theodore Stien, of Frankfort-on-the-Main, Germany, under a commission duly issued by the Circuit Court of the Unsted States for the District of New Jersey, in a suit wherein The American Bell Telephone Company was plaintiff, and The Overland Telephone Company defendant, shall be considered and regarded, and shall be printed as testimony in this suit, together with this stipulation.

It is, however, understood and agreed that in case any part of such testimony is, by order of the Court, on adversary proceedings suppressed, such part thereof so suppressed shall be regarded and considered as suppressed in this suit.

DICKERSON & DICKERSON,
Compl't's Sol'rs.
MILLER, PECKHAM & DIXON,
Def't's Sol'rs.

December 27, 1884.

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UNITED STATES CIRCUIT COURT,

DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY AGAINST THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.	In Equity.

ST. JAMES' HOTEL, No. 77 PICCADILLY,
LONDON, ENGLAND,
SATURDAY, JULY 19th, 1884.

Answers to interrogatories to Thomas Ballard, of Bristol, England, named in the foregoing commission—a witness produced before the Commissioner for examination on the part of the defendants in the above-stated cause.

The witness having been sworn by the ceremony in answer to defendant's first direct interrogatory, which is as follows:

State your name, age, residence and occupation, said:

Thomas Ballard; age, thirty-eight and one-half years; residence, Bristol, England; occupation, philosophical intrument maker.

In answer to the defendant's second direct interrogatory which is as follows:

Where did you live in 1865, and what was your business at that time?

The witness said:

Dublin, Ireland; my business at that period was apprentice to Mr. Horatio Yeates, of Dublin, who was a philosophical instrument maker.

In answer to defendant's third interrogatory which is as follows:

If you say that during that year you were apprenticed to Mr. Stephen M. Yeates, an instrument maker, in Dublin, Ireland, state whether you were present at any telephone experiments made by Mr. Yeates during that year.

The witness said:

I was not apprenticed to Mr. Stephen Yeates, but to Mr. Horatio Yeates, his brother, who carries on the same business in Dublin. Mr. Horatio Yeates kept a workshop principally, and we did most of Mr. Stephen Yeates' work, which necessitated going backward and forward between the two houses very often, at least every day.

I was present at telephone experiments in my capacity as an apprentice. I believe I was present when most of the important experiments were going on, but being an apprentice could not give a great deal of attention to the experiments.

In answer to the defendant's fourth interrogatory, which is as follows:

If you were present at such experiments, state in what capacity you acted, and what part you took in such experiments, the nature of the instrument used, and the general results of the experiments and the circumstances connected with them so far as you can recall them.

The witness said:

I was present and acted as an apprentice. I took no active part in the experiments, but probably assisted in them, without being exactly aware what part of the work I was performing. The instrument used was Reis' early instrument. That I can state positively, because I paid great attention to the instrument, and had an opportunity of examining it, and did so. I did not only recognize the instrument from drawings which I saw in the German book, Defendant's Exhibit Volume 2 of Das Buch der Enfindenungen, but I recognized the drawings I saw there from the recollection I have of the instrument, and I am quite positive that it was a Reis instrument.

I firmly believe that the instrument was at Mr. Yeates' in Dublin more than a year before 1865; I will positively swear it was there more than 18 months prior to 1865, and I think it must have been there two years before 1865. That is when I saw the instrument first. I saw it frequently.

In 1865 my master, Mr. Horatio Yeates, having removed his business to London, I worked for Mr. Stephen Yeates for three or four months as a temporary help, while his brother started a fresh business in London.

In 1865 I have a distinct recollection that the telephone question came up again, and that is what makes me so certain of the thing laying in abeyance for some time. In the latter part of 1865 the transmission of articulate speech by the Reis telephone was a

common subject of conversation amongst people in Dublin and amongst Mr. Stephen Yeates' hands. I had conversations with a workman, Mr. Charles Hales, who I believe is now dead, who did most of Mr. Stephen Yeates' electrical work, and who assisted in the experiments I speak of, and with others in the house in the latter part of 1865, about this matter of the Reis telephone being made to speak.

The general result of the experiments was that it was an acknowledged and accepted fact among Mr. Yeates' workmen; that Mr. Yeates had made Reis' telephone speak, and when Mr. Bell's telephone came up in 1876, it was a common thing among the men to say that Mr. Yeates had got Reis' telephone to speak ten or twelve years before, and Mr. Bell's telephone did not astonish me in the least.

In answer to defendant's last direct interrogatory, which is as follows:

Do you know or can you set forth any other matter or thing which may be of benefit or advantage to the parties at issue in this cause or either of them, or that may be material to the subject of this your examination, or the matters in question in this cause? If yea, set forth the same fully and at large in your answer.

The witness says:

I can only say this, that in the winter of 1867–1868, Mr. Stephen Yeates visited his brother, Mr. Horatio Yeates, in London, and they had a conversation in the workshop. I was present and heard the conversation. Among other things the conversation turned on the Reis telephone experiments, and what struck me and makes me remember the thing particularly is that I heard Mr. Stephen Yeates distinctly mention the use of a drop of water at the contacts. I did not know what it meant then, but of course now I do. That drop of water at the contacts would be calculated to make the instrument speak, and I believe now from what I know about telephones (and I know a great deal) that that drop of water referred to the drop of water at the contacts, I believe that instrument could be made to speak with a drop of water then. But I have heard the Reis instrument speak in its simple form, within the last two or three weeks in my own shop. At the same time I am convinced that the instrument did speak in 1865, for at that time there were assemblies of scientific men in Mr. Yeates' shop, and I have heard the conversation turn on the point of the Reis instrument having spoken, and speculating as to how it might have happened.

When I speak of the Reis instrument speaking in my shop within the last two or three weeks I mean the Reis transmitter; I do not mean to say that, that with the Reis musical receiver the instrument can be heard to speak, and I mean to use the Reis transmitter with an ordinary Bell receiver. When the news of the Bell telephone first reached Dublin I had a conversation with Mr. Farley, who in the year 1868 did business in part of house occupied by Mr. Yeates, and he stated to me that in the year 1865 he had distinctly heard the Reis telephone talk; he is now dead.

CROSS INTERROGATORIES.

In answer to the complainant's first cross interrogatory which is as follows: Are you not the author of the book entitled Elementary lessons on Electricity and Magnetism, by Silvanus P. Thompson, B. A., 1881, and are you not the author of the fifth edition of that book published in London by Macmillan & Co. in 1884, and annex copies of the two editions to your depositions?—the witness said:

No.

In answer to complainant's second cross-interrogatory which is as follows: Assuming that you will swear in reply to 23d interrogatory that the several Reis publications with which you were familiar prior to 1876, were sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus and how to use the same for the production of articulate speech. Will you explain to the Court why you did not know that in 1881, when you published the 435th paragraph, page 400, in your book on Electricity and Magnetism, that "in 1876 Graham Bell invented the articulating telephone," and why in the index of that book you say Telephone, Graham Bell, articulating, and why in that same book in the 434th paragraph you described Reis Telephone in the manner which you did?—the witness said:

I know nothing about that.

In answer to the complainant's third cross-interrogatory which is as follows: Between the date of the first edition of your book and the fifth, did you not take out two British patents. The first numbered 2578, dated May 31st, 1882, and the second numbered 3803, dated August 9, 1883?—the witness said:

I know nothing about that.

In answer to the complainant's fourth cross-interrogatory, which is as follows: Since the publication of your first edition have you

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not become associated as consulting electrician for the London & Globe Telephone and Construction Co.—a corporation working in opposition to the United Telephone Company, representing the invention of Graham Bell in England, and does not your name appear in the advertisements of that company, as one of its officers?—the witness says:

I know nothing about that.

In answer to the complainant's fifth cross-interrogatory, which is as follows: Were you not a witness for the defendants in this case of the United Telephone Company (limited) against Harrison, Cox, Walker & Co., in the High Court of Justice, Chancery Divison, in which judgment was delivered May 10th, 1882?—the witness said:

No, sir.

In answer to the complainant's sixth cross-interrogatory, which is as follows: In that case did you not testify as is reported in the "Electrical Review" (London), May 25th, 1882, and as follows:

"Professor Thompson considered that the change in the resist-
"ance which took place in carbon under pressure was due to surface
"contact, only his own experiments proved that the pressure only
"increased the area of the surface contact. Reis's transmitter was
"intended by the inventor to work as a make and break contact
"instrument, and the inventor expected it to produce articulate
"speech by this action. As a matter of fact, Reis did obtain artic-
"ulate sounds, but this was when the instrument worked in a man-
"ner which it was not intended it should. Professor Thompson
"was not aware that, prior to Bell's patent, anybody had written to
"the effect that Reis's transmitter acted in any other way than as a
"make and break instrument. The witness had himself heard a
"Reis instrument transmit articulate speech." And did you not testify to the same effect?—the witness said:

I did not.

In answer to the complainant's seventh cross-interrogatory, which is as follows: Are you not the author of a book entitled "Philipp Reis, inventor of the Telephone, by Silvanus P. Thompson, B.A., London, 1883?"—the witness said:

No.

In answer to the complainant's eighth cross-interrogatory, which is as follows: In that book, page 41, you say, "As far as Professor Dolbear is concerned, therefore, he admits in unequivocal terms the whole claim of Reis to be the inventor of the telephone." Did you not know when you published that statement, that Professor Dol-

bear was interested in the defense of a suit in the United States, which the American Bell Telephone Company was complainant, and Dolbear and others defendants, in which the defense was in part founded upon the assertion that Philipp Reis was the inventor of the telephone, and in which the inventions of Philipp Reis were used to limit the scope of Bell's patent?—the witness said:

No.

In answer to the complainant's ninth cross-interrogatory, which is as follows: Did you not know that Albert Stretson, named in the preface of that book, was the agent of and employed by Professor Dolbear, as the defendant in that case, to collect the evidence of Reis' invention, for the purpose of maintaining the defense, and did not you consult with and assist said Stretson in his effort in that direction?—the witness said:

No.

In answer to the complainant's tenth cross interrogatory, which is as follows: Who besides yourself contributed money to the publication of the book, and the procuring of the information contained in it, entitled "Philipp Reis, inventor of the Telephone?"—the witness said:

I know nothing of that.

In answer to the complainant's eleventh cross-interrogatory, which is as follows: Did you not know that that information was procured in part, at least, by persons acting for the defendants, who were defending against the Bell patent in the United States, and that one object of the publication was to discredit Professor Bell as the inventor of the articulate telephone?—the witness said:

I know nothing about that.

In answer to the complainant's twelfth cross-interrogatory, which is as follows: Does the paragraph entitled Third Form, the Electro-magnet Receiver, on the 30th page of that book, contain a true statement of the operation of the electro-magnet receiver of Reis, a diagram of which is found on the 32d page?—the witness said:

I do not know the book, consequently I cannot answer the question.

In answer to the complainant's thirteenth cross-interrogatory, which is as follows: In the apparatus described by you in your two patents for the transmission of articulate speech, is not the method of that transmission by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds

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uttered to the transmitter, or, in the language of Sir William Thompson, "does not the strength of the electrical current vary "continuously and as nearly as may be in simple proportion to the "velocity of a particle of air engaged in constituting the sounds," when your apparatus works to transmit articulate speech?—the witness said:

I know nothing about the matter.

In answer to the complainant's fourteenth cross-interrogatory, which is as follows: If you deny this, will you explain to the Court what you understand to be the relation between the current on the line wire and the movement of the particles of air when your apparatus speaks?—the witness said:

I know nothing about the matter.

In answer to the complainant's fifteenth cross-interrogatory, which is as follows: Has any apparatus of yours, patented or otherwise, been used by any persons or corporations in Great Britain who are not licensed under the inventions of Bell or Edison?—the witness said:

No telephone apparatus of mine has been so used.

The last interrogatory being again propounded to the witness he stated that he had nothing to add to his answer previously given thereto.

(Sgd.)

THOMAS BALLARD.

Sworn and subscribed before me this 19th day of July, 1884.

S. D. OLIPHANT,
Com., &c.

UNITED STATES CIRCUIT COURT,

DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY AGAINST THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.	In Equity.

Testimony taken at Dublin, Ireland, on Saturday the 26th day of July, 1884, before S. D. Oliphant, Esq., the Commissioner herein, on interrogatories filed pursuant to the order of the Court.

WILLIAM FRAZER, a witness called on behalf of the defendants, being sworn, testified as follows in answer to the interrogatories propounded to him:

1. In answer to defendant's first direct interrogatory, which is as follows: State your name, age, residence and occupation?—witness says:

My name is William Frazer; I am 59 years of age, and reside at 20 Harcourt street, Dublin; fellow and member of Court of Examiners, Royal College of Surgeons, Ireland; member of Council of the Royal Irish Academy; fellow Royal Geological Society of Ireland.

2. In answer to defendant's second direct interrogatory, which is as follows: Are you acquainted with Stephen M. Yeates, an instrument maker, in the City of Dublin, Ireland, and how long have you known him?—witness says:

Intimately for upwards of 30 years.

3. In answer to defendant's third direct interrogatory, which is as follows: Did you know of any telephone experiments made by Mr. Yeates in 1865? If yea, state where and when such experiments were made, the nature of the instrument with which they were made, and the result of such experiments?—witness says:

The telephone was first shown me by Mr. Stephen Yeates at a meeting of the Dublin Philosophical Society, held in November, 1865, at his brother's, Horatio Yeates, 13 Leicester street, Dublin;

he explained its construction and some modifications which he suggested and carried out. The transmitter was taken upstairs to a room and the receiver placed in the hall, where I heard the voices of different speakers and recognized them. I also heard portions of musical airs, of which I recollect Home, Sweet Home, Jump Jim Crow, and God Save the Queen. The sentences were short, such as: Who am I? Do you hear me? Who is speaking now? The replies were made through the medium of a person standing in the lobby, who communicated the answers to those inside the room.

For the scientific description of the instrument used I would refer to Mr. Yeates.

4. In answer to defendant's fourth direct interrogatory, which is as follows: Did you take any part in making such experiments, and if so, state fully the circumstances connected with them, and give the names of any other persons who took part in such experiments? —witness says:

I was so interested in these experiments that at my request Mr. Yeates publicly exhibited the instrument at a Conversatione held in the Rotunda on Tuesday, November 22d, 1865, for the Young Men's Central Association, in connection with the Presbyterian Church. Mr. Tuke took charge of the telephone, which was first placed in a side room and afterwards the receiver was removed to the centre room to permit a greater length of wire and enable more persons to hear it in action. It was in constant use during the evening, and as I had it and other scientific objects under my immediate charge, it was my duty to direct our visitors' attention to it. I refer to the advertisement of this meeting in "Saunder News Letter," of 20th November, 1865, and to a notice in it of the persons present, in the issue November 22d; amongst them were the Lord Mayor, Mr. Green, afterwards Member of Parliament, and Recorder of Derry; the late Dr. Moore, Curator of our Botanic Gardens; the Presbyterian Minister of Dublin, and the Rev. Dr. Watson, of Limerick; the moderator, the Rev. John Hall, now of New York, and several others.

5. In answer to defendant's fifth direct interrogatory, which is as follows: Have you any written memoranda relating to such experiments made at the time; if so, state the circumstances under which such memoranda were made and annex a copy thereof to your deposition?—witness says:

My private note book for the year 1865 contains brief notes of the dates of this public meeting and of the club meetings, which

enable me to refer to the notices in "Saunder's News Letter." I kept no notes of the special experiments, but distinctly recollect all the circumstances I have stated. The month October, given in my letter to Professor Silvanus Thompson, is an error and refers to a previous meeting of the club, as I find on careful search.

COPY OF LETTER OF MARCH 8TH, 1883.

MARCH 8TH, 1883.

DEAR SIR—I am informed that you were present at the meeting of the Dublin Philosophical Society, in December, 1865, when "Reis's" Telephone was shown by Mr. S. M. Yeates.

As I am about publishing a volume on the early telephone of Reis, I should be glad of any information you could give about that which occurred on that occasion. Mr. Yeates, who is my informant, thinks that you may perhaps remember the names of some of those who were present, and whose voices were heard through the telephone. If you can recall any of the words that were transmitted by the instruments, I should be very glad to hear of them, and whether they were distinctly articulated. Apologizing for intruding upon your attention, believe me

Your obt. servant,
SYLVANUS P. THOMPSON.

W. FRAZER, ESQ., M.D.

A true copy of letter referred to by Dr. Frazer in his answer to the 10th Cross-Interrogatory.

July 26th, 1884.

S. D. OLIPHANT,
Com., &c.

COPY OF LETTER OF MARCH 13TH, 1884.

UNIV. COLL., BRISTOL, March 13th, 1884.

DR. W. FRAZER:

DEAR SIR—Pray accept my sincere thanks for your explicit account of the telephone experiments. I have only to ask that you will permit me to print your letter *verbatim*, amongst a number of

others I have received from Professer Tunike, Heidelburg, Dr. Messel, and others, in the volume which I am preparing concerning Reis invention. All the wood-cuts and practically all the letter-press is ready. I shall give myself the pleasure of sending you a copy when it is finished. Believe me,

Dear sir,

Yours faithfully,

SILVS. P. THOMPSON.

A true copy of letter referred to by Dr. Frazer in his answer to the 10th Cross-Interrogatory.

July 26th, 1884.

S. D. OLIPHANT,
Com., &c.

CROSS-INTERROGATORIES.

In answer to the complainant's first cross-interrogatory which is as follows: Are you not the author of the book entitled Elementary Lessons on Electricity and Magnetism, by Silvanus P. Thompson, B. A., 1881, and are you not the author of the fifth edition of that book published in London by Macmillan & Co. in 1884, and annex copies of the two editions to your depositions?—the witness said:

No, certainly not.

In answer to complainant's second cross-interrogatory which is as follows: Assuming that you will swear in reply to 23d interrogatory that the several Reis publications with which you were familiar prior to 1876 were sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus and how to use the same for the production of articulate speech. Will you explain to the Court why you did not know that in 1881, when you published the 435th paragraph, page 400, in your book on Electricity and Magnetism, that "in 1876 Graham Bell invented the articulating telephone," and why in the index of that book you say Telephone, Graham Bell, articulating, and why in that same book in the 434th paragraph you described Reis Telephone in the manner which you did?—the witness said:

I know nothing of it.

In answer to the complainant's third cross-interrogatory which is as follows: Between the date of the first edition of your book

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and the fifth did you not take out two British patents—the first numbered 2578, day, May 31st, 1882, and the second numbered 3803, dated August 9, 1883?—the witness said:

No.

In answer to the complainant's fourth cross-interrogatory which is as follows: Since the publication of your first edition have you not become associated as consulting electrician for the London & Globe Telephone and Construction Co.—a corporation working in opposition to the United Telephone Company, representing the invention of Graham Bell in England, and does not your name appear in the advertisements of that company as one of its officers?—the witness says:

No.

In answer to the complainant's fifth cross-interrogatory, which is as follows: Were you not a witness for the defendants in this case of the United Telephone Company (limited) against Harrison, Cox, Walker & Co., in the High Court of Justice, Chancery Division, in which judgment was delivered May 10th, 1882?—the witness said:

No.

In answer to the complainant's sixth cross-interrogatory, which is as follows: In that case did you not testify as is reported in the "Electrical Review" (London), May 25th, 1882, and as follows: "Professor Thompson considered that the change in the resist- "ance which took place in carbon under pressure was due to surface "contact, only his own experiments proved that the pressure only "increased the area of the surface contact. Reis's transmitter was "intended by the inventor to work as a make and break contact "instrument, and the inventor expected it to produce articulate "speech by this action. As a matter of fact, Reis did obtain artic- "ulate sounds, but this was when the instrument worked in a man- "ner which it was not intended it should. Professor Thompson "was not aware that, prior to Bell's patent, anybody had written to "the effect that Reis's transmitter acted in any other way than as a "make and break instrument. The witness had himself heard a "Reis instrument transmit articulate speech." And did you not testify to the same effect?—the witness said:

No.

In answer to the complainant's seventh cross-interrogatory, which is as follows: Are you not the author of a book entitled "Philipp Reis, inventor of the Telephone, by Silvanus P. Thompson, B.A., London, 1883?"—the witness said:

No.

In answer to the complainant's eighth cross-interrogatory, which is as follows: In that book, page 41, you say, "As far as Professor Dolbear is concerned, therefore, he admits in unequivocal terms the whole claim of Reis to be the inventor of the telephone." Did you not know when you published that statement, that Professor Dolbear was interested in the defense of a suit in the United States, which the American Bell Telphone Company was complainant, and Dolbear and others defendants, in which the defense was in part founded upon the assertion that Philipp Reis was the inventor of the telephone, and in which the inventions of Philipp Reis were used to limit the scope of Bell's patent?—the witness said:

No.

In answer to the complainant's ninth cross-interrogatory, which is as follows: Did you not know that Albert Stretson, named in the preface of that book, was the agent of and employed by Professor Dolbear, as the defendant in that case, to collect the evidence of Reis' invention, for the purpose of maintaining the defense, and did not you consult with and assist said Stretson in his effort in that direction?—the witness said:

No.

In answer to the complainant's tenth cross-interrogatory, which is as follows: Who besides yourself contributed money to the publication of the book, and the procuring of the information contained in it, entitled "Philipp Reiss, inventor of the Telephone?"—the witness said:

I contributed no money; my letter to Sylvanus P. Thompson was in reply to a letter of his which I exhibit, but would prefer to keep it; I also produce his answer and will annex copies of both to my deposition.

In answer to the complainant's eleventh cross-interrogatory, which is as follows: Did you not know that that information was procured in part, at least, by persons acting for the defendants, who were defending against the Bell patent in the United States, and that one object of the publication was to discredit Professor Bell as the inventor of the articulate telephone?—the witness said:

Certainly not.

In answer to the complainant's twelfth cross-interrogatory, which is as follows: Does the paragraph entitled Third Form, the Electro-magnet Receiver, on the 30th page of that book, contain a true statement of the operation of the electro-magnet receiver of

Reis, a diagram of which is found on the 32d page?—the witness said:

I cannot answer the question.

In answer to the complainant's thirteenth cross-interrogatory, which is as follows: In the apparatus described by you in your two patents for the transmission of articulate speech, is not the method of that transmission by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds uttered to the transmitter, or, in the language of Sir William Thompson, "does not the strength of the electrical current vary "continuously and as nearly as may be in simple proportion to the "velocity of a particle of air engaged in constituting the sounds," when your apparatus works to transmit articulate speech?—the witness said:

I cannot answer because I have no knowledge of the subject.

In answer to the complainant's fourteenth cross-interrogatory, which is as follows: If you deny this, you will explain to the Court what you understand to be the relation between the current on the line wire and the movement of the particles of air when your apparatus speaks?—the witness said:

I repeat my last answer.

In answer to the complainant's fifteenth cross-interrogatory, which is as follows: Has any apparatus of yours, patented or otherwise, been used by any persons or corporations in Great Britain who are not licensed under the inventions of Bell or Edison?—the witness said:

No.

To the last interrogatory the witness says:

No.

(Signed)

WILLIAM FRAZER.

Sworn and subscribed before me the 26th day of July, 1884.

S. D. OLIPHANT,
Comr., &c.

UNITED STATES CIRCUIT COURT,

DISTRICT OF NEW JERSEY.

[In Equity.]

THE AMERICAN BELL TELEPHONE COMPANY

AGAINST

THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.

Testimony taken before S. D. OLIPHANT, ESQ., the Commissioner appointed herein, by order of the Court of June 9th, 1884, at Dublin, Ireland, on Saturday, July 26th, 1884, on interrogatories filed.

STEPHEN M. YEATES, a witness sworn in behalf of the defendants, in answer to the interrogatories propounded to him, testifieth as follows:

1. In answer to defendant's first direct interrogatory, which is as follows: State your name, age, residence and occupation?—witness says:

My name is Stephen M. Yeates; I am 52 years of age, and reside at 2 Grafton street, Dublin, Ireland; I am an optician.

2. In answer to defendant's second direct interrogatory, which is as follows: Have you been familiar with the manufacture of electrical instruments and accustomed to make experiments with such instruments, and for what length of time and to what extent?—witness says:

I have been actively engaged in the construction of electrical apparatus and experimenting with the same for the last twenty-five years.

3. In answer to defendant's third direct interrogatory, which is as follows: Did you, prior to 1865, obtain possession of a telephone of the form shown in the publications known as the "Reis Prospectus," and did you make any experiments with that instrument; and if so, at what time and under what circumstances and with what results?—witness says:

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In the autumn of 1865, I purchased of Mr. William Ladd, of London, a model of the Reis Telephone. I do not know the publications known as Reis Prospectus. During the months of October and November, 1865, I experimented with the Reis Telephone, and made several modifications of it.

4. In answer to defendant's fourth direct interrogatory, which is as follows: If, in your experiments, you made any modification of the Reis instrument obtained by you, state the nature of such modification and describe any experiments made by you with the instrument so modified?—witness says:

The improvements I made consisted in rejecting the knitting needle arrangement of Reis and substituting therefor an electro-magnetic receiver of my own design, which consisted of a horseshoe electro-magnet with an adjustable armature.

By a careful adjustment of this receiver it was quite easy to get both the quality and amplitude of notes sung into the transmitter. When this result was obtained I observed that the armature was in absolute contact with both forks of the electro-magnet, and that the magnet did not at any time lose its magnetism, but that the effects were due to an alteration of intensity in the magnetism of the iron core. Having succeeded so far with the receiver, I next turned my attention to the Reis transmitter, when I soon discovered that the chief defect in it was the too freely tossing of the little contact pin from the platinum plate on which it rested; the first plan which occurred to me to obviate this defect was to make the pin dip into a conducting fluid, and I made the experiment by simply wetting the pin with my tongue; this greatly improved the sounds transmitted, but owing to the electic action I was obliged to abandon that plan. Before experimenting further I exhibited this telephone at the November meeting of the Dublin Philosophical Society in 1865, held at 13 Leinster street, Dublin, when after explaining and experimenting with it, the receiver was removed from the room of meeting in the second floor to the hall (wires being led down the stairs). Songs sung into the transmitter on the second floor were distinctly heard in the receiver down stairs, and various questions asked, some words which were clearly recognized and the peculiar characteristics of each voice were markedly noticeable; some of the songs sung on that occasion were "St. Patrick's Day" (sung by Mr. W. Rigby), "Home, Sweet Home" and "God Save the Queen."

The same instrument was exhibited a few evenings after at a Conversatione of the Young Men's Christian Association at the

Rotunda, Dublin, where the transmitter was fixed in one room and the receiver in another room at some distance. The song, "Home, Sweet Home," was transmitted with great clearness.

5. In answer to defendant's fifth direct interrogatory, which is as follows: Have you in your possession any instrument made by you from descriptions in the Reis publication prior to 1876; and if not, state where such instrument is at this time, and if you have a cut or drawing of it annex it to your deposition?—witness says:

The instrument here referred to I was induced to sell on December the 16th, 1865, in its imperfect state to the Rev. M. Kernan, then Professor of Experimental Physics in College, where I believe it is still to be seen. The instrument which I bought of Mr. Ladd was what is known as the Reis instrument, shown in figure 29 on page 86 of the book called Phillip Reis Invention of the Telephone, by Professor S. P. Thompson, published by E. and F. M. Spon, 1883, and also shown on page 348 of the Book of Invention, volume 2, now shown to me by the Commissioner, and marked as an exhibit July 10th, 1884. Professor Thompson's book on page 128 also contains a drawing of the receiver made by me, which I have referred to.

6. In answer to defendant's sixth direct interrogatory, which is as follows: Was a man named Thomas Ballard apprenticed to you at any time prior to 1876 while making experiments with the Reis telephone; and if so, at what time?—witness says?

Thomas Ballard was not in my employment; he was apprenticed to my brother, Mr. Horatio Yeates, then of 13 Leinster street, Dublin, now of street, Adelaide, South Australia.

CROSS-INTERROGATORIES.

In answer to the complainant's first cross-interrogatory which is as follows: Are you not the author of the book entitled Elementary Lessons on Electricity and Magnetism, by Silvanus P. Thompson, B. A., 1881, and are you not the author of the fifth edition of that book published in London by Macmillan & Co., in 1884, and annex copies of the two editions to your depositions?—the witness said:

No.

In answer to complainant's second cross-interrogatory which is as follows: Assuming that you will swear in reply to 23d interroga-

tory that the several Reis publications with which you were familiar prior to 1876 were sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus and how to use the same for the production of articulate speech. Will you explain to the Court why you did not know that in 1881, when you published the 435th paragraph, page 400, in your book on Electricity and Magnetism, that "in 1876 Graham Bell invented the articulating telephone," and why in the index of that book you say Telephone, Graham Bell, articulating, and why in that same book in the 434th paragraph you described Reis Telephone in the manner which you did?—the witness said:

I can make no answer to the question.

In answer to the complainant's third cross-interrogatory which is as follows: Between the date of the first edition of your book and the fifth did you not take out two British patents—the first numbered 2578, dated May 31st, 1882, and the second numbered 3803, dated August 9, 1883?—the witness said:

I don't know of the matter referred to at all.

In answer to the complainant's fourth cross-interrogatory which is as follows: Since the publication of your first edition have you not become associated as consulting electrician for the London & Globe Telephone and Construction Co.—a corporation working in opposition to the United Telephone Company, representing the invention of Graham Bell in England, and does not your name appear in the advertisements of that company as one of its officers—the witness says:

No.

In answer to the complainant's fifth cross interrogatory, which is as follows: Were you not a witness for the defendants in this case of the United Telephone Company (limited) against Harrison, Cox, Walker & Co., in the High Court of Justice, Chancery Division, in which judgment was delivered May 10th, 1882?—the witness said:

No.

In answer to the complainant's sixth cross-interrogatory, which is as follows: In that case did you not testify as is reported in the "Electrical Review" (London), May 25th, 1882, and as follows: "Professor Thompson considered that the change in the resistance "which took place in carbon under pressure was due to surface "contact, only his own experiments proved that the pressure only

"increased the area of the surface contact. Reis's transmitter was "intended by the inventor to work as a make and break contact "instrument, and the inventor expected it to produce articulate "speech by this action. As a matter of fact, Reis did obtain artic- "ulate sounds, but this was when the instrument worked in a man- "ner which it was not intended it should. Professor Thompson "was not aware that, prior to Bell's patent, anybody had written to "the effect that Reis's transmitter acted in any other way than as a "make and break instrument. The witness had himself heard a "Reis instrument transmit articulate speech." And did you not testify to the same effect?—the witness said:

I did not.

In answer to the complainant's seventh cross-interrogatory which is as follows: Are you not the author of a book entitled "Philip Reis, inventor of the Telephone, by Silvanus P. Thompson, B. A., London, 1883?"—the witness said:

No.

In answer to the complainant's eighth cross-interrogatory, which is as follows: In that book, page 41, you say, "As far as Professor Dolbear is concerned, therefore he admits in unequivocal terms the whole claim of Reis to be the inventor of the telephone." Did you not know when you published that statement, that Professor Dolbear was interested in the defense of a suit in the United States, in which the American Bell Telephone Company was complainant, and Dolbear and others defendants, in which the defense was in part founded upon the assertion that Philip Reis was the inventor of the telephone, and in which the inventions of Philip Reis were used to limit the scope of Bell's patent?—the witness said:

I know nothing about it.

In answer to the complainant's ninth cross-interrogatory, which is as follows: Did you not know that Albert Stretson, named in the preface of that book, was the agent of and employed by Professor Dolbear, as the defendant in that case, to collect the evidence of Reis' invention, for the purpose of maintaining the defense, and did not you consult with and assist said Stretson in his effort in that direction?—the witness said:

No.

In answer to the complainant's tenth cross-interrogatory, which is as follows: Who besides yourself contributed money to the publication of the book, and the procuring of the information contained

in it, entitled "Philipp Reiss, inventor of the Telephone?"—the witness said:

I did not contribute and do not know of others doing so.

In answer to the complainant's eleventh cross-interrogatory, which is as follows: Did you not know that that information was procured in part, at least, by persons acting for the defendants, who were defending against the Bell patent in the United States, and that one object of the publication was to discredit Professor Bell as the inventor of the articulate telephone?—the witness said:

No; I do not.

In answer to the complainant's twelfth cross-interrogatory, which is as follows: Does the paragraph entitled Third Form, the Electro-magnet Receiver, on the 30th page of that book, contain a true statement of the operation of the electro-magnet receiver of Reis, a diagram of which is found on the 32d page?—the witness said:

I do not know.

In answer to the complainant's thirteenth cross-interrogatory, which is as follows: In the apparatus described by you in your two patents for the transmission of articulate speech, is not the method of that transmission by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds uttered to the transmitter, or, in the language of Sir William Thompson, "does not the strength of the electrical current vary "continuously and as nearly as may be in simple proportion to the "velocity of a particle of air engaged in constituting the sounds," when your apparatus works to transmit articulate speech?—the witness said:

I don't know the apparatus referred to.

In answer to the complainant's fourteenth cross-interrogatory, which is as follows: If you deny this, you will explain to the Court what you understand to be the relation between the current on the line wire and the movement of the particles of air when your apparatus speaks?—the witness said:

I cannot answer the question.

In answer to the complainant's fifteenth cross-interrogatory, which is as follows: Has any apparatus of yours, patented or otherwise, been used by any persons or corporations in Great Britain who are not licensed under the inventions of Bell or Edison?—the witness said:

No.

The last interrogatory being again propounded to the witness he stated:

I know of nothing further.

(Signed,)

STEPHEN M. YEATES.

Sworn and subscribed before me this 26th day of July, 1884.

S. D. OLIPHANT,
Com., &c.

UNITED STATES CIRCUIT COURT,
DISTRICT NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY AGAINST THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.	In Equity.

Testimony taken at Dublin, Ireland, on Saturday, the 26th day of July, 1884, before S. D. Oliphant, Esqr., the commissioner herein on interrogataries filed pursuant to the order of the Court.

A. M. VEREKER, a witness sworn on behalf of the defendant, in answer to interrogatories propounded to him, testifieth as follows:

1. In answer to defendant's first direct interrogatory, which is as follows: State your name, age, residence and occupation?—witness says:

My name is Amos M. Vereker; I am 56 years of age, and reside at 31 Wellington Place, Clyde Road, Dublin; I am the deputy Cashier of the Bank of Ireland, Dublin.

2. In answer to defendant's second direct interrogatory, which is as follows: Are you acquainted with Stephen M. Yeates, an in-

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strument maker, in the City of Dublin, Ireland; and if so, how long have you known him?—witness says:

I am personally acquainted with Mr. Stephen M. Yeates, optician, &c., Dublin, and have known him for 35 years and upwards.

3. In answer to defendant's third direct interrogatory, which is as follows: Were you present in the year 1865 at any telephonic experiments made by Mr. Yeates in Dublin; and if so, state the form and nature of the instrument used in those experiments, the general nature of the experiments and the results obtained?—witness says:

I was present at the meeting of the Philosophical Society in November, 1865, referred to, at which meeting Mr. Yeates exhibited his improvements in Reis Telephone. The Telephone transmitter was the square box form, having the mouth piece inserted in one side and diaphragm on the top, the receiver being an electro magnet placed vertically over an orifice in a resonant box.

4. In answer to defendant's fourth direct interrogatory, which is as follows: Did you personally take part in such experiments; and if so, state what part you took, who were present with you and whether you heard articulate speech or words of songs spoken through that instrument, and, generally, the circumstances connected with the experiments, so far as you recollect them?—witness says:

The transmitter and battery were in an upper room in the house of Mr. Horatio Yeates, 13 Leinster street, where the meeting of the society was held, the receiver being in the hall, the connecting wires were carried under the intervening doors, and down the stairs, words and sentences were spoken, and songs were sung into the transmitter and were generally understood and recognized, more particularly the songs, and the voices in each case were unmistakable. I personally took part in the above, and recollect distinctly hearing "Home Sweet Home," and "God Save the Queen" sung, short questions asked quite intelligibly. Mr. S. M. Yeates, Mr. Horatio Yeates, Dr. Frazer, Mr. W. Rigby and I think one or two others, whose names I do not recollect, were also present.

CROSS-INTERROGATORIES.

In answer to the complainant's first cross-interrogatory which is as follows: Are you not the author of the book entitled Elementary

Lessons on Electricity and Magnetism, by Silvanus P. Thompson, B. A., 1881, and are you not the author of the fifth edition of that book published in London by Macmillan & Co. in 1884, and annex copies of the two editions to your depositions?—the witness said:

No.

In answer to complainant's second cross-interrogatory which is as follows: Assuming that you will swear in reply to 23d interrogatory that the several Reis publications with which you were familiar prior to 1876 were sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus and how to use the same for the production of articulate speech. Will you explain to the Court why you did not know that in 1881, when you published the 435th paragraph, page 400, in your book on Eelctricity and Magnetism, that "in 1876 Graham Bell invented the articulating telephone," and why in the index of that book you say Telephone, Graham Bell, articulating, and why in that same book in the 434th paragraph you described Reis Telephone in the manner which you did?—the witness said:

I have no knowledge of the matters referred to.

In answer to the complainant's third cross-interrogatory which is as follows: Between the date of the first edition of your book and the fifth did you not take out two British patents—the first numbered 2578, dated May 31st, 1882, and the second numbered 3803, dated August 9, 1883?—the witness said:

I did not.

In answer to the complainant's fourth cross-interrogatory which is as follows: Since the publication of your first edition have you not become associated as consulting electrician for the London & Globe Telephone and Construction Co.—a corporation working in opposition to the United Telephone Company, representing the invention of Graham Bell in England, and does not your name appear in the advertisements of that company as one of its officers?—the witness says:

No.

In answer to the complainant's fifth cross-interrogatory, which is as follows: Were you not a witness for the defendants in this case of the United Telephone Company (limited) against Harrison, Cox, Walker & Co., in the High Court of Justice, Chancery Division, in which judgment was delivered May 10th, 1882?—the witness said:

No.

In answer to the complainant's sixth cross-interrogatory, which is as follows: In that case did you not testify as is reported in the "Electrical Review" (London), May 25th, 1882, and as follows: "Professor Thompson, considered that the change in the resist- "ance which took place in carbon under pressure was due to surface "contact, only his own experiments proved that the pressure only "increased the area of the surface contact. Reis's transmitter was "intended by the inventor to work as a make and break contact "instrument, and the inventor expected it to produce articulate "speech by this action. As a matter of fact, Reis did obtain artic- "ulate sounds, but this was when the instrument worked in a man- "ner which it was not intended it should. Professor Thompson "was not aware that, prior to Bell's patent, anybody had written to "the effect that Reis's transmitter acted in any other way than as a "make and break instrument. The witness had himself heard a "Reis instrument transmit articulate speech." And did you not testify to the same effect?—the witness said:

No.

In answer to the complainant's seventh cross-interrogatory, which is as follows: Are you not the author of a book entitled "Philipp Reis, inventor of the Telephone, by Silvanus P. Thompson, B. A., London, 1883?"—the witness said:

No.

In answer to the complainant's eighth cross-interrogatory, which is as follows: In that book, page 41, you say, "As far as Professor Dolbear is concerned, therefore, he admits in unequivocal terms the whole claim of Reis to be the inventor of the telephone." Did you not know when you published that statement, that Professor Dolbear was interested in the defense of a suit in the United States, in which the American Bell Telephone Company was complainant, and Dolbear and others defendants, in which the defense was in part founded upon the assertion that Philipp Reis was the inventor of the telephone, and in which the inventions of Philipp Reis were used to limit the scope of Bell's patent?—the witness said:

I know nothing of it.

In answer to the complainant's ninth cross-interrogatory, which is as follows: Did you not know that Albert Stretson, named in the preface of that book, was the agent of and employed by Professor Dolbear, as the defendant in that case, to collect the evidence of Reis' invention, for the purpose of maintaining the defense, and did

not you consult with and assist said Stretson in his effort in that direction?—the witness said:

No.

In answer to the complainant's tenth cross-interrogatory, which is as follows: Who besides yourself contributed money to the publication of the book, and the procuring of the information contained in it, entitled "Philipp Reis, inventor of the Telephone?"—the witness said:

I did not nor do I know who did.

In answer to the complainant's eleventh cross-interrogatory, which is as follows: Did you not know that that information was procured in part, at least, by persons acting for the defendants, who were defending against the Bell patent in the United States, and that one object of the publication was to discredit Professor Bell as the inventor of the articulate telephone?—the witness said:

I do not.

In answer to the complainant's twelfth cross-interrogatory, which is as follows: Does the paragraph entitled Third Form, the Electro-magnet Receiver, on the 30th page of that book, contain a true statement of the operation of the electro-magnet receiver of Reis, a diagram of which is found on the 32d page?—the witness said:

I do not know.

In answer to the complainant's thirteenth cross-interrogatory, which is as follows: In the apparatus described by you in your two patents for the transmission of articulate speech, is not the method of that transmission by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds uttered to the transmitter, or, in the language of Sir William Thompson, "does not the strength of the electrical current vary "continuously and as nearly as may be in simple proportion to the "velocity of a particle of air engaged in constituting the sounds," when your apparatus works to transmit articulate speech?—the witness said:

I took out no patents and cannot give any answer.

In answer to the complainant's fourteenth cross-interrogatory, which is as follows: If you deny this, you will explain to the Court what you understand to be the relation between the current on the line wire and the movement of the particles of air when your apparatus speaks?—the witness said:

I cannot answer the question.

In answer to the complainant's fifteenth cross-interrogatory, which is as follows: Has any apparatus of yours, patented or otherwise, been used by any persons or corporations in Great Britain who are not licensed under the inventions of Bell or Edison?—the witness said:

No.

The last interrogatory being propounded to the witness he stated:

I would state that Mr. Edward Tuke, a witness named in the Commission, has been dead since May last, also the only Mr. Rigby who attended our meetings in 1865, was Mr. William Rigby, and he has informed me that he does not remember the facts with sufficient clearness to testify to them. Mr. John Rigby was a member of the Dublin Philosophical Society from its foundation in 1849, until about 1860, but did not attend any of the experiments made with Reis telephone.

(Signed,)

A. W. VEREKER.

Sworn and subscribed before me this 26th day of July, 1884.

S. D. OLIPHANT,
Com., &c.

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UNITED STATES CIRCUIT COURT,

DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY AGAINST THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.	In Equity.

Testimony taken at Frankfort-on-the-Main, Germany, on Monday the 4th day of August, 1884, before S. D. Oliphant, Esq., the Commissioner herein, on interrogatories filed pursuant to the order of the Court.

The testimony being taken through Alvesto S. Hague, as interpreter, who was first sworn by the Commissioner to faithfully, truly and correctly translate the oath to the witness—and, the oath having been administered, afterwards, to faithfully, truly and correctly translate to the witness the several direct and cross-interrogatories propounded to him by the Commissioner and the answer made thereto by the witness.

JOHANN EHREN, a witness called on behalf of the defendants and named in the Commission, having been sworn (through the medium of the interpreter) by the ceremony of the uplifted hand, in answer to the several interrogatories propounded to him, testified as follows:

1. In answer to defendant's first direct interrogatory, which is as follows: State your name, age, residence and occupation?—witness says:

My name is Johann Ehren. I am sixty-two years of age, reside at Frankfort-on-the-Main, Germany, and am by occupation teacher of mechanics, chemistry, physics and the ancient languages.

2. In Inswer to defendant's second direct interrogatory, which is as follows: Were you acquainted with Philip Reis, formerly of Friedericksdorf, in Germany, who died in 1874; and if so, how long did you know him?—witness says:

From the year 1853 I instructed Phillip Reis, of Gelnhausen, in mathematics and physics. I gave Reis these lessons in the so-called Mohren Garden, where the Hotel du Nord now stands, rented from the piano manufacturer, Meggenhoffer. In a short time my efforts with Reis extended not only to the above-named instructions, but we instituted strictly scientific experiments concerning light, heat, electricity and magnetism, and about the commencement of the year 1856 began the particular work of the telephone.

3. In answer to defendant's third direct interrogatory, which is as follows: Did you ever work for Mr. Reis; and if so, in what capacity?—withness says:

I worked daily from that time on with Reis, and as he placed great confidence in my honesty I learned to know all the forms of the telephone, as the same are described in Professor Silvanus Thompson's excellent work, published in 1883, entitled, Phillip Reis, Inventor of the Telephone.

4. In answer to defendant's fourth direct interrogatory, which is as follows: Did you, while working with Mr. Reis, become familiar with any forms of his telephone as described in the printed publications relating to him; if so, describe those instruments fully, and state in detail the circumstances and nature of the work you did for him, and the results of the experiments made by him with those instruments, so far as they came under your personal observation?—witness says:

A description of the apparatus is unnecessary, and I refer, therefore, to the Professor Silvanus P. Thompson's work, Phillip Reis, Inventor of the Telephone, pages 16 to 27, where the transmitters which we employed are accurately described, likewise the receivers, from page 29 to 34, are exactly the same, and notably in figure 33, page 100, the connection of the transmitter with the receiver is correctly portrayed as we used it in our experiments. The results were astonishing, but Reis could not make up his mind to appear before the public with his invention, because he was one of those characters who in his burning zeal could not finish.

5. In answer to defendant's fifth direct interrogatory, which is as follows: While you were working with Mr. Reis, what were the purposes to which he endeavored to apply the instruments made by him and used in the experiments in which you assisted him?—witness says:

If it is claimed that Reis had in his mind to transmit musical sounds only in an electro-musical way, that is a great error, even

the name "Telephone" (from "Telos" and phone, and the last is called according to the best dictionaries which I used—for Reis understood neither the Latin nor the Greek language, voice, speech, language or cry) indicates most unequivocally the purpose the inventor ascribed to the telephone.

6. In answer to defendant's sixth direct interrogatory, which is as follows: Did you during those experiments personally hear articulate speech transmitted through those instruments, or any of them; if so, state the circumstances in detail?—witness says:

Our principal attention, studies and experiments were devoted to the speaking telephone, and Reis and I were the only mortals who had knowledge of it. His first experiments in the presence of a few acquaintances like Albert & Son, mechanics, concerned only the transmission of musical sounds, the strictest secrecy was preserved concerning the speaking telephone. We tried first single vowels and consonants, then monosyllables, and afterwards words of more syllables and short sentences. It did not go well at first, but afterwards the trials succeeded to our satisfaction, as we were able to transmit words and short sentences.

In the year 1858 Reis and I disagreed, because I ascribed the blame of the still present incompleteness to the membrane, and made the proposition to place a metal plate in the place of the same. Reis rejected this opinion entirely, and thenceforth proceeded his way alone.

7. In answer to defendant's seventh and last direct interrogatory, which is as follows: Do you know or can you set forth any other matter or thing which may be of benefit to the parties at issue in this cause, or either of them, or that may be material to the subject of this your examination, or the matters in question in this cause; if yea, set forth the same fully and at large in your answer?—witness says?

From the foregoing it follows:

1st. That the Reis telephone from the beginning was to be not only an apparatus for transmitting musical sounds, but rather a speaking telephone.

2d. That the telephone was not invented in Friedrichsdorf, but was invented in the course of the years 1856 to 1858 in Frankfort-on-the-Main, in the so-called Mohren Garden, in Meggenhofer's shop.

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CROSS-INTERROGATORIES.

In answer to the complainant's first cross-interrogatory which is as follows: Are you not the author of the book entitled Elementary Lessons on Electricity and Magnetism, by Sylvanus P. Thompson, B. A., 1881, and are you not the author of the fifth edition of that book published in London by Macmillan & Co. in 1884, and annex copies of the two editions to your depositions?—the witness says:

No.

In answer to complainant's second cross-interrogatory which is as follows: Assuming that you will swear in reply to 23d interrogatory that the several Reis publications with which you were familiar prior to 1876 were sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus and how to use the same for the production of articulate speech. Will you explain to the Court why you did not know that in 1881, when you published the 435th paragraph, page 400, in your book on Electricity and Magnetism, that "in 1876 Graham Bell invented the articulating telephone," and why in the index of that book you say Telephone, Graham Bell, articulating, and why in that same book in the 434th paragraph you describe Reis Telephone in the manner which you did?—the witness said:

I can make no answer.

In answer to the complainant's third cross-interrogatory which is as follows: Between the date of the first edition of your book and the fifth did you not take out two British patents—the first numbered 2578, dated May 31st, 1882, and the second numbered 3803, dated August 9, 1883?—the witness said:

No.

In answer to the complainant's fourth cross-interrogatory which is as follows: Since the publication of your first edition have you not become associated as consulting electrician for the London & Globe Telephone and Construction Co.—a corporation working in opposition to the United Telephone Company, representing the invention of Graham Bell in England, and does not your name appear in the advertisements of that company as one of its officers?—the witness says:

No.

In answer to the complainant's fifth cross-interrogatory, which is as follows: Were you not a witness for the defendants in this case

of the United Telephone Company (limited) against Harrison, Cox, Walker & Co., in the High Court of Justice, Chancery Division, in which judgment was delivered May 10th, 1882?—the witness said:

No.

In answer to the complainant's sixth cross-interrogatory, which is as follows: In that case did you not testify as is reported in the "Electrical Review" (London), May 25th, 1882, and as follows: "Professor Thompson considered that the change in the resistance which took place in carbon under pressure was due to surface "contact, only his own experiments proved that the pressure only "increased the area of the surface contact. Reis's transmitter was "intended by the inventor to work as a make and break contact "instrument, and the inventor expected it to produce articulate "speech by this action. As a matter of fact, Reis did obtain articulate sounds, but this was when the instrument worked in a manner which it was not intended it should. Professor Thompson "was not aware that, prior to Bell's patent, anybody had written to "the effect that Reis's transmitter acted in any other way than as a "make and break instrument. The witness had himself heard a "Reis instrument transmit articulate speech." And did you not testify to the same effect?—the witness said:

No.

In answer to the complainant's seventh cross-interrogatory, which is as follows: Are you not the author of a book entitled "Philipp Reis, inventor of the Telephone, by Silvanus P. Thompson, B. A., London, 1883?"—the witness said:

Certainly not.

In answer to the complainant's eighth cross-interrogatory, which is as follows: In that book, page 41, you say, "As far as Professor Dolbear is concerned, therefore, he admits in unequivocal terms the whole claim of Reis to be the inventor of the telephone." Did you not know when you published that statement, that Professor Dolbear was interested in the defense of a suit in the United States, in which the American Bell Telephone Company was complainant, and Dolbear and others defendants, in which the defense was in part founded upon the assertion that Philipp Reis was the inventor of the telephone, and in which the inventions of Philipp Reis were used to limit the scope of Bell's patent?—the witness said:

I cannot answer the question.

In answer to the complainant's ninth cross-interrogatory, which is as follows: Did you know that Albert Stretson, named in the

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preface of that book, was the agent of and employed by Professor Dolbear, as the defendant in that case, to collect the evidence of Reis' invention, for the purpose of maintaining the defense, and did not you consult with and assist said Stretson in his effort in that direction?—the witness said:

No.

In answer to the complainant's tenth cross-interrogatory, which is as follows: Who besides yourself contributed money to the publication of the book, and the procuring of the information contained in it, entitled "Philipp Reis, inventor of the Telephone?"—the witness said:

No.

In answer to the complainant's eleventh cross-interrogatory, which is as follows: Did you not know that that information was procured in part, at least, by persons acting for the defendants, who were defending against the Bell patent in the United States, and that one object of the publication was to discredit Professor Bell as the inventor of the articulate telephone?—the witness said:

No.

In answer to the complainant's twelfth cross-interrogatory, which is as follows: Does the paragraph entitled Third Form, the Electro-magnet Receiver, on the 30th page of that book, contain a true statement of the operation of the electro-magnet receiver of Reis, a diagram of which is found on the 32d page?—the witness said:

It does; Figures 22 and 23, page 33, show a more complete form.

In answer to the complainant's thirteenth cross-interrogatory, which is as follows: In the apparatus described by you in your two patents for the transmission of articulate speech, is not the method of that transmission by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds uttered to the transmitter, or, in the language of Sir William Thompson, "does not the strength of the electrical current vary "continuously and as nearly as may be in simple proportion to the "velocity of a particle of air engaged in constituting the sounds," when your apparatus works to transmit articulate speech?—the witness said:

I cannot answer the question.

In answer to the complainant's fourteenth cross-interrogatory, which is as follows: If you deny this, you will explain to the Court

what you understand to be the relation between the current on the line wire and the movement of the particles of air when your apparatus speaks?—the witness said:

I cannot answer the question.

In answer to the complainant's fifteenth cross-interrogatory, which is as follows: Has any apparatus of yours, patented or otherwise, been used by any persons or corporations in Great Britain who are not licensed under the inventions of Bell or Edison?—the witness said:

No.

The last interrogatory being again propounded to the witness, he stated:

I have nothing further to add.

(Sgd.,)

JOHANN EHREN.

Sworn and subscribed before me this 4th day of August, 1884.

S. D. OLIPHANT,
Com., &c.

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UNITED STATES CIRCUIT COURT.

DISTRICT NEW JERSEY.

[IN EQUITY.]

THE AMERICAN BELL TELEPHONE COMPANY

vs.

THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.

Testimony taken at Frankfort-on-the-Main, Germany, on Monday, the 4th day of August, 1884, by S. D. Oliphant, Esq., the Commissioner herein on interrogatories filed pursuant to the order of the Court.

THEODORE STEIN, a witness named in the Commission, and called on behalf of the defendants, being conscientiously scrupulous of taking an oath, was at his own request affirmed, and in answer to the several interrogatories propounded to him by the Commissioner, testifieth as follows:

1. In answer to the defendant's first direct interrogatory, which is as follows: State your name, age, residence and occupation?—witness says:

My name is Segismund Theodore Stein, I am forty-four and one-half years old, residence Frankfort-on-the-Main, Germany; my occupation is that of a doctor of medicine and electrician.

2. In answer to defendant's second direct interrogatory, which is as follows: Are you acquainted with Philip Reis, formerly of Fridericksdorf, in Germany: and if so, how long did you know him? —witness says:

I know Phillip Reis, formerly of Friedricksdorf, in Germany, it is true, in consequence of his lectures delivered at Frankfort on the Main. This was in the years 1860 and 1861. I have not had, however, any personal relations with him.

3. In answer to defendant's third direct interrogatory, which is as follows: Were you present in 1861 at the meeting of the Physical Society of Frankfort in the City of Frankfort, at an exhibition

of Philip Reis of the telephone described by him in the annual report of that society for 1860 and 1861, and known as the "Bored Block" instrument; if you were present at that meeting, did you see and have in your possession the instrument shown by Mr. Reis on that occasion?—witness says:

I was not present at the meeting of the Physical Society of Frankfort-on-the-Main, in the year 1861, when Reis, for the first time demonstrated his telephone, but I came, a short time after, to the then president of the Physical Society, Professor Dr. Böttger, who was in possession of a Bored Block Telephone constructed by Phillip Reis. This Board Block Telephone afterwards came into my possession and I took the same, in the year 1862, with me to Erlangen, at which place I was then studying.

4. In answer to defendant's fourth direct interrogatory, which is as follows: Do you know where the identical instrument then used by Philip Reis now is, and who is the present owner of it; if so, state your means of knowledge, and if the instrument itself is produced before you at the time of your examination, identify it before the Commissioner and cause it to be marked by him, and annex to your deposition an accurate drawing or photograph of it?—witness says:

I cannot say, by my own inspection, whether the instrument which I then possessed, is the same which Reis demonstrated at that meeting. it was, however, designated to me by Professor Dr. Böttger, as one of those which Reis then produced. This instrument, which the Commissioner of the Circuit Court of the United States, for the District of New Jersey, now shown me, consisting of two parts, and marked "Reis, Frankfort Instrument," is the same instrument, so designated by Professor Dr. Böttger—I obtained possession of it as my property as early as the year 1862, and it is the same which, in November, 1882, I delivered to Professor Silvanus P. Thompson, of Bristol, England.

5 and lastly. In answer to defendant's fifth direct interrogatory, which is as follows: Do you know or can you set forth any other matter or thing which may be of advantage or benefit to the parties at issue in this cause, or either of them, or that may be material to the subject of this your examination or the matters in question in this cause; if yea, set forth the same fully and at large in your answer?—witness says:

The name of Dr. Thomas Stein is erroneously given in the Commission, inasmuch as no Dr. Stein, with the christian name

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"Thomas" has lived in Frankfort during the last thirty years, and I am the person who delivered the instrument in question to Professor Thompson, and to whom the questions are evidently directed.

(Signed,)

SEGISMUND THEODORE STEIN,
Doctor of Medicine and Philosophy.

Affirmed and subscribed before me this 4th day of August, 1884.

S. D. OLIPHANT,
Com. &c.

The cross interrogatories propounded by the complainant being read to the witness, Dr. Theodore Stein, he refused to answer them because he said he knew nothing about them as they were evidently intended to be addressed to another person.

August 4th, 1884.

S. D. OLIPHANT,
Com., &c.

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UNITED STATES CIRCUIT COURT.

DISTRICT OF NEW JERSEY.

IN EQUITY.

THE AMERICAN BELL TELEPHONE COMPANY,

vs.

THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, ET AL.

On Bill, etc.

Application having been made on the part of the defendants by A. Q. Keasbey, their counsel, for the issuing of a commission to examine Prof. Silvanus P. Thompson of Bristol, England, Thomas Ballard of Bristol, England, Stephen M. Yates, optician, of Dublin, Ireland, [Wm.] Rigby of Dublin, Ireland, John Rigby of Dublin, Ireland, A. M. Vererker, manager of the Bank of Ireland and Dublin, Ireland, E. C. Tuke of Dublin, Ireland, Dr. William Frazer of Dublin, Ireland, Dr. J. Ehren of 35 Wohlerstrasse, Frankfort-on-the-Main, Germany, and Dr. Thomas Stein of Frankfort, Germany, and after hearing Mr. E. N. Dickerson, counsel for the complainant, in opposition to the issuing of any commission applied for, it is ordered that such commission do issue, and thereupon the parties having agreed that in case such commission be ordered, it may be directed to S. Duncan Oliphant, the clerk of this court, who is to be in England during July next, for the execution of a commission in another case, by consent, provided that a stipulation be filed consenting to the appointment of the clerk as commissioner.

Dated June 9, 1884.

JNO. T. NIXON, *J.*

A true copy.

S. D. OLIPHANT,

[SEAL.] *Clerk*

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The President of the United States of America, to S. Duncan Oliphant, Esq., Clerk of the United States
[L. S.] *Circuit Court for the District of New Jersey. Greeting:*

Know ye, that we, in confidence of your prudence and fidelity, have appointed you commissioner, and by these presents do give you full power and authority diligently to examine upon their respective corporal oaths or affirmations before you to be taken, Prof. Silvanus P. Thompson, of Bristol, England; Thomas Ballard, of Bristol, England; Stephen M. Yates, optician, of Dublin, Ireland; William Rigby, of Dublin, Ireland; John Rigby, of Dublin, Ireland; A. M. Vererker, Manager of the Bank of Ireland and Dublin, Ireland; E. C. Tuke, of Dublin, Ireland; Dr. William Frazer, of Dublin, Ireland; Dr. J. Ehren, of 35 Wohlerstrasse, Frankfort on the Main, Germany, and Dr. Thomas Stein, of Frankfort, Germany, as witnesses in a cause now pending and undetermined in equity in the Circuit Court of the United States of America for the District of New Jersey, wherein the American Bell Telephone Company is complainant, and the Overland Telephone Company, of New Jersey and others are defendants, on the part of the defendants, touching the premises on the interrogatories hereunto annexed.

And we do hereby require you, before whom such testimony may be taken, to reduce the same to writing, and to close iu up under your hand and seal, directed to the Clerk of the Circuit Court of the United States of America for the District of New Jersey, Trenton, New Jersey, United States.

And that you return the same when executed as above directed, annexed to this writ, with the title of the cause endorsed on the envelope of the commission into the said Circuit Court before the Judges thereof, with all convenient speed.

Witness the Honorable Morrison R. Waite, Chief Jus-

tice of the Supreme Court of the United States, at the city of Trenton, New Jersey, United States, in said district, this twenty-third day of June, in the year of our Lord eighteen hundred and eighty-four.

S. DUNCAN OLIPHANT,
Clerk, &c.

A. Q. KEASBEY,
Solicitor and of Counsel for Defendants.

A true copy.

[SEAL.] S. D. OLIPHANT, *Clerk.*

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UNITED STATES CIRCUIT COURT.

DISTRICT OF NEW JERSEY.

IN EQUITY.

THE AMERICAN BELL TELEPHONE COMPANY,

vs.

THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.

Complainant's objections to interrogatories filed by the defendants to be annexed to commission to be issued.

Complainant objects to the fourth, fifth, sixth, seventh, eighth, ninth and tenth interrogatories to Silvanus P. Thompson, because they are irrelevant and immaterial to the issue in this case. When Silvanus P. Thompson first saw or heard of the Reis telephone; what information he had about it before 1876; what printed publications he was cognizant of; what instruments he saw constructed according to those publications; when he first saw the telephone described by Legat; whether he made any experiments with it; and whether, before 1876, he knew of such a thing as an undulatory current, are not matters competent for the defendant to prove in this case. If the thing patented by Bell had been known to Silvanus P. Thompson in Europe, it would not be competent to defeat his patent, much less his knowledge of Reis's apparatus.

Complainant objects to the eleventh, twelfth, thirteenth, fourteenth, fifteenth, sixteenth, seventeenth, eighteenth, ninteenth and twentieth interrogatories, because they are questions addressed to Silvanus P. Thompson as an expert, calling for his opinion as such; and there appearing no reason why the complainants should be subjected to the ex-

pense of employing counsel to cross-examine an expert abroad when defendants in this case have already examined several experts of the highest professional character, and having had also the expert testimony in other cases by other defendants introduced into their case, where the experts have been examined and cross-examined orally. The complainant submits to the court that expert testimony abroad ought not to be permitted to be taken by commissioner, unless it appears that, for some reason, the defendants cannot obtain the testimony where the witnesses can be cross-examined; and it also being evident that no expert can be cross-examined by cross-interrogatories in writing, since it is impossible to anticipate what opinions he may express upon the subject.

Complainant objects to the twenty-first and twenty-second interrogatories, because it is immaterial what Silvanus P. Thompson heard when experimenting prior to 1876 with the Reis instrument, or whether the announcement of Bell's invention in 1876 was the announcement of a new art to the proposed witness. The answer of the defendants does not set up Silvanus P. Thompson as a person having prior knowledge of the invention; and if it did, that knowledge must have been in this country and not in Europe in order to be competent.

Complainant objects to the twenty-third interrogatory because, first, it calls for a mere expert opinion; and, secondly, because it does not appear that the witness was in this country, or had any knowledge in this country derived from those publications.

Complainant objects to the twenty-fourth interrogatory because the supposed foreign publication was not set up in the answer in this case; and, therefore, cannot be proved.

Complainant objects to the twenty-fifth interrogatory because it is entirely immaterial whether the witness has in his possession the original instrument shown by Phillip Reis at Frankfort in 1861, or at any other time. The defense set up in the answer in this case is founded upon the publications of Phillip Reis, and the fact of an instrument having been made in Germany is not competent evidence, either under the defence as it is made, or under any defence

which the law provides. It is neither a publication nor a patent.

Complainant objects to all the interrogatories proposed to Thos. Ballard, Stephen M. Yates, William Rigby, John Rigby, A. M. Vererker, E. C. Tuke and William Frazer, because it is not relevant or competent for the defendants to prove that any of these witnesses in Dublin, Ireland, were present at any telephone experiments in the year 1865. If the very thing patented by Professor Bell had been exhibited in Dublin in 1865, it would not have constituted any defence to that patent. And these witnesses are not set up in the answer as persons having prior knowledge of the invention of Professor Bell. If they had been, upon exceptions their names would have been struck out of the answer, since their knowledge was in Dublin, Ireland, and not in the United States.

Complainant objects to all the interrogatories to Dr. J. Ehren and Dr. Thomas Stein, because they are not set up in the answer as persons having a prior knowledge of the invention patented by Professor Bell; and because it is immaterial what Reis did, either in their presence or otherwise, in Germany in 1859, unless it was patented or published. The instrument which Phillip Reis had in Germany is not set up in the answer as an anticipation of the patent of Professor Bell; and if it had been, an exception to the answer would have been filed. It cannot be produced in evidence under the plea of publication by Phillip Reis of his invention.

DICKERSON & DICKERSON,
Complainant's Solicitors.

A true copy.

S. D. OLIPHANT,
[SEAL.] *Clerk.*

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CIRCUIT COURT OF THE UNITED STATES.

DISTRICT OF NEW JERSEY.

IN EQUITY.

THE AMERICAN BELL TELEPHONE COMPANY,
vs.
THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.

June 26th, 1884.

In the above entitled cause the objections to the interrogatories filed, addressed to Silvanus P. Thompson, Thomas Ballard, Stephen M. Yates, William Rigby, John Rigby, A. M. Vererker, E. C. Tuke, Dr. William Frazer, Dr. J. Ehren, Dr. Thos. Stein, coming on to be heard, it is ordered that the objections be overruled, and the interrogatories be allowed.

JNO. T. NIXON, *J.*

The complainants except to the ruling allowing the interrogatories and will move to suppress the depositions taken under the same.

A true copy.

[L. S.] S. D. OLIPHANT, *Clerk.*

The testimony of all the witnesses examined under the commission, except Sylvanus P. Thomson, was made a part of the testimony for the defendants in the Molecular case, and will be found printed with the proofs in that case.

The testimony of Sylvanus P. Thompson is as follows:

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UNITED STATES CIRCUIT COURT.

DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY
vs.
THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY.

In Equity.

ST. JAMES' HOTEL, 77 Piccadilly,
London, England,
July 10th, 1884.

Answer to interrogatories administered to Sylvanus P. Thompson, of Bristol, England, named in the foregoing commission; a witness produced before the commissioner for examination on the part of the defendants in the above stated cause.

The witness stated that he had conscientious scruples against taking an oath, and was at his own request affirmed, as follows: "I, Sylvanus Phillip Thompson, being a member of the Society of Friends commonly called Quakers, do hereby solemnly, truly and sincerely affirm and declare, that the answers I shall make to the questions propounded to me by the defendant in this case, shall be the truth, the whole truth and nothing but the truth; and to this I most solemnly affirm."

In answer to the defendants' first direct interrogatory which is as follows:

State your name, age, residence and occupation?

The witness said:

Sylvanus Phillip Thompson, age 33, residence 12 Beaconsfield road, Clifton, Bristol; occupation, professor of experimental physics, in University College, Bristol.

In answer to defendants' second direct interrogatory which is as follows:

How long and to what extent have you been engaged in

the study of physical science, and what attention if any, have you given to the subject of electricity, electrical apparatus, acoustics, and telephonic transmission of sound?

The witness said:

I have been engaged in the study of physical science since the year 1870; in fact, before that, when I was at school, I learned a great deal, but since the year 1870, I have been continually teaching and studying physical science, and have made a specific object of study, the science of electricity and the science of optics and acoustics. Since the year 1875 I have given a great deal of attention to the subject of electric telephony.

In answer to the defendants' third direct interrogatory which is as follows:

What, if any, books have you published relating to electric science?

The witness said:

I have published a text book of electricity and magnetism, having for its title "Elementary lessons in Electricity and Magnetism," which book has been sold in large quantities in England and America, and is the accepted text book of the subject in a large proportion of the science schools and colleges in England. I have also published lectures on dynamo electric machines, which have been republished in America and in France. And in addition to this I have written a large number of scientific memoirs, many of which are reprinted separately in pamphlet form.

In answer to the defendants' fourth direct interrogatory, which is as follows:

When and under what circumstances did you first hear of Reis's telephone?

The witness said:

I first saw Reis's telephone during my Easter holiday in the year 1875 when on a visit to Manchester. I was at that time residing in the city of York, and held the post of Science Master in the Friends' School of York. The instrument was shown to me amongst the collection of physical apparatus belonging to Owen's College, Manchester. I

had not previously heard of Reis's Telephone, nor was I aware that such an instrument existed. The custodian of the collection, who showed me the instrument, described to me how the transmitter was set up in one room and the receiver in another, and how a battery was placed in the circuit; he told me that you had to speak or sing to the transmitter and listen to the receiver. I was much taken with the idea on account of its extreme scientific interest and novelty. The transmitter was of the square box pattern, similar to that described in Reis's own published prospectus, and the receiver was, as nearly as I can remember, a knitting needle receiver of the pattern also shown in the prospectus.

The answer to the defendants' fifth direct interrogatory, which is as follows:

What information had you prior to 1876 about the nature of Reis's invention?

The witness said:

In addition to the information which I received in Manchester, I learned from several sources additional facts. Prior to the year 1876 I found a notice of Reis's telephone in "Ferguson's Electricity" published several years before, and I also found in volume 20 of a German Encyclopedia of Physics a description of Reis's telephone similar to the one I had seen in Manchester, and that description was preceded by a description of another form of telephone which I understood at the time to have been invented by a person named Legat, but which I now know was in reality the invention of Reis, described by Legat.

In answer to the defendants' sixth direct interrogatory which is as follows:

What printed publication bearing upon Reis's telephone were you cognizant of prior to 1876?

The witness said:

I do not remember any publications other than those I have just named in my previous answer.

In answer to the defendant's seventh direct interrogatory which is as follows:

Did you prior to 1876 see any telephone or telephones made like the apparatus described in the printed publications concerning Reis's telephone, and if so, describe those instruments, and state whether you heard, prior to 1876, articulate speech transmitted by them or any of them?

The witness said:

The only telephones which I saw prior to 1876 were the instruments shown me at Manchester, and some experimental forms constructed by myself, subsequently with which I made experiments. The transmitter shown me at Manchester was a hollow square box with a mouthpiece at the side, and carried on its upper surface a membrane, stretched over a circular aperture. Upon the top of the membrane there were the usual contact pieces united to binding screws in the manner common to all the square box Reis's transmitter. I do not recollect the details of construction of the receiver which I saw at Manchester, beyond the fact that it was a knitting needle instrument, standing on a sound board. The instrument which I constructed with the assistance of my brother, after returning home was very crude. The transmitter consisted of a jam pot covered with a piece of bladder, a hole being knocked in the side of the pot into which we could speak, and on the top of the membrane I arranged a thin piece of copper wire ending in a small disk of platinum foil, and over this there lay a crooked piece of copper wire resting lightly against the platinum disk. I tried several receivers of knitting needle form, but found better results, when I placed a small electro magnet, belonging to the school collection, inside a biscuit tin, so that the varying attractions of the poles of the magnet might cause the side of the box to vibrate. With this crude apparatus my brother and I transmitted a large number of more or less intelligible sentences —such words as "hurrah" and "cock-a-doodle doo" being perfectly well understood. We also transmitted songs, and I very well remember hearing laughter transmitted by this apparatus.

In answer to the defendants' eighth direct interrogatory which is as follows:

When were you first acquainted with the form of telephone described by "Legat" in the journal of the Austro-German Telegraph Union, Zeitschrift des Deutschoesterreichischen Telegraphen Vereins 1862, vol., 9?

The witness said:

I was first acquainted with the form of telephone described by Legat in the journal of the Austro-German Telegraph Union, by finding pictures of it, and a somewhat abbreviated description of it, in the pages of the German Encyclopedia of Physics, mentioned in my reply to the fifth interrogatory, and which I imagined, as I have said, to be Legat's telephone, not knowing at the time it was Reis's.

In answer to the defendants' ninth direct interrogatory which is as follows:

Have you made any experiments as to the form of Reis's telephone, as described in the printed publications concerning the same before 1876, which is best adapted for transmitting speech? If so, state them in detail, and state what reasons you can give, why one of the forms is better than the others.

The witness said:

I have made experiments, as to the powers of the different forms of instrument, for transmitting speech and I am inclined to think, that the best form of transmitter, is the one described by Legat in the journal of the Austro-German Telegraph Union, and I think it is better than the other forms of transmitter described by Reis in the printed publications, because the diaphragm is set vertically instead of horizontally, as in most of the other forms, and because the diaphragm is smaller in diameter in proportion and therefore, if made of similar material would be relatively stiffer. Moreover in this instrument there is an adjusting screw to the spring contact, precisely resembling the adjusting screw for the spring contacts described in some of Edison's earlier specifications for speaking telephones, but it is not stated either in Legat's description, nor in the description given in

the German Encyclopedia of Physics, what material Reis employed for the curved lever which forms a prominent feature in this form of transmitter. It is a little difficult to pronounce with certainty whether this instrument, as originally constructed, will work better or worse than instruments made from the drawings and having levers, possibly not made of the same material which Reis employed. At the same time, I consider the square box pattern of instrument, in which there is a gravity contact instead of a spring contact, less liable to get out of order in consequence of change of temperature or of moisture of the air. With respect to the receivers, I consider the knitting needle receiver to be more convenient for hearing when provided with the upper sounding board or cover against which the ear can be pressed. There is no such convenient means for applying the ear to the electro magnetic receiver, figured and described by Legat—it is true that Legat says in his description that an elliptical cavity may be added as a sort of ear piece to the instrument, but it is not clear from the description how such an adjunct is to be applied. I have heard speech delivered faithfully by both forms of receiver.

In answer to the defendants' tenth direct interrogatory, which is as follows:

Did you before 1876 know of such a thing as an undulatory current? If so, state the sources of your knowledge, and the nature of the apparatus which, in operation, produced such a current.

The witness said:

Before 1876 I had learned, and was in the habit of teaching, that various circumstances would give rise to an undulatory current. It was a matter of common knowledge, to be found in the text books of electricity and on the telegraph. I had also heard the thing mentioned in lectures, and had seen experiments made involving the use of undulatory currents. I was aware, for example, that an undulatory current is produced by a magneto electric machine, not provided with a commutator to commute the undulations of the current generated in the revolving coils of

the armature. I was aware also, of the existence of several kinds of telegraphic instruments, for example, some of those devised by Wheatstone and by Henley, in which there was no battery employed, but in which undulatory currents were generated in a closed circuit by moving coils in the neighborhood of permanent magnets. And I was aware also that Varley had proposed to use such undulatory currants in some of his telegraphic systems. I was also aware that in signalling through submarine cables it was found to be impossible to get an abrupt current to pass, and that the effect of static induction in cables was to transform all abrupt electric disturbances into electric undulations. I was aware also that on every circuit in which there is either static induction or self-induction or mutual induction, the only currents which could be caused to pass were currents which rose in gradual waves or undulations. It was also familiar knowledge to me that if at any point of a circuit, the contact was defective or loose, there was a resistance offered at that point, which resistance could be diminished by screwing up more tightly or by applying pressure. I was also familiar with the equations of Helmotz in the mathematical theory of electricity, which deal with the undulations which occur in a current traversing a circuit in which there is self-induction.

In answer to the defendants' eleventh direct interrogatory, which is as follows:

Do you consider an undulatory current necessary for the transmission of speech?

The witness said:

Understanding by an "undulatory current" a current defined as undulatory by Bell in his specification No. 174,465, and of a nature agreeing with the diagrams of curves given by Bell in the said specification, I reply very emphatically that such an undulatory current is certainly not necessary for the transmission of speech, because currents undulating in a manner such as would be represented by the wave forms shown by Bell could correspond only to the following things:

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Firstly—Musical tones which correspond to simple recurring wave forms, termed in mathematics "sinusoidal curves."

Secondly—Chords or combinations of musical tones corresponding to the more complex wave forms shown by Bell.

Thirdly—Vowel sounds, which are known to be like chords, simply combinations of simple musical tones.

Consequently, because speech does not consist of musical tones, chords and vowels only, but consists of a great many other elements, consonants, rhythm and emphasis, and all sorts of abrupt transitions and intermissions, it is perfectly clear to my own mind, that no amount of undulatory currents, such as are described by Bell, could ever transmit articulate speech.

In answer to defendants' twelfth direct interrogatory, which is as follows:

If your answer to the eleventh interrogatory is in the negative, state what, if any, causes would tend to produce a current upon the line, and affecting the receiver, which would be similar in its results to the so-called undulatory current which Alexander Graham Bell has described in his patent of March 7th, 1876, issued by the United States Patent office, and numbered 174,465?

The witness said:

The cause that would tend to produce a current upon the line, and affecting the receiver and which would be similar in its results to the so-called undulatory current, may be considered under two heads. First, any continuous musical tone or combination of tones, such as sustained chords or vocal sounds, acting upon a suitable transmitter would set up currents similar to these. Also single, individual undulations in the current might be produced by any cause which tended to increase or diminish the strength of the current, provided the circuit were one in which there is induction. Further, single undulations and also successions of undulations might be produced by a loose contact apparatus, such as the mechanism of Reis's telephone, provided there were any elasticity or flabbiness in the material of the con-

tact pieces or of the mountings of the contact pieces; in fact, if the contact pieces were in themselves elastic, or were mounted either upon membrane or wood or springs, it would be absolutely impossible to produce sudden transitions in the strength of the current, which would rise and fall in undulations instead. If there were elasticity in the mountings, or if there were induction in the circuit, it would be absolutely impossible to produce a current of the kind which Bell calls direct pulsatory, as distinguished from undulatory, because it would be impossible under those circumstances to cause the strength of the current to rise and fall properly; it would inevitably rise and fall in waves.

In answer to the defendants' thirteenth direct interrogatory, which is as follows:

Do all the essential parts of articulate speech consist of undulations, such as are described by Bell in his patent, number 174,465, March 7th, 1876? If not, describe fully what elements of articulate speech cannot be represented by such curves as Bell mentions and shows in that specification?

The witness said:

Very few of the essential features of articulate speech consist of undulations such as are described by Bell. On the contrary, the majority of the consonantal sounds cannot be represented. The dental sounds, such as the letters T and D, which are explosive and not undulatory in their character, cannot be represented by periodic waves; neither can the labials; neither can the periods of silence which intervene between the actual sounds, and which in themselves constitute a really important part in intelligible articulation. Every time a man utters the letter "P," as, for instance, in saying, "Peter Piper picked a peck of pickled peppers," he lets out from between his lips a small explosion of air, and an explosion cannot be represented, as a succession of small smooth ripples or waves. The same is true of the majority of consonantal sounds; they are not recurrent, they are not undulatory, in type.

In answer to the defendants' fourteenth direct interrogatory, which is as follows:

Does Mr. Bell in that specification describe anything under the term undulations except such as can be represented by a sinusoidal curve or by the resultant of several sinusoidal curves?

The witness said:

He does not. All of his curves are of a simple harmonic type, or represent simple combinations of harmonic wave sounds. They are all, so to speak, smooth ripples, having no sharp crests and, as I have before said, can therefore only correspond to musical chords, tones and vowels.

In answer to defendants' fifteenth direct interrogatory, which is as follows:

Do any of the sounds used in speech consist of motions that can be so represented?

The witness said:

They do. The vowels in the first place can be so represented. And in my opinion, although it is not generally accepted so as a scientific fact, the sound of the letters S and Z ought to be included under the term "vowels," because, like the vowels, they are capable of being sustained, and consist of exceedingly shrill, and nearly regular undulations.

In answer to the defendants' sixteenth direct interrogatory, which is as follows:

Is it true as alleged by Bell, that cable dispatches may be transmitted more rapidly by undulatory curves than by means of an intermittent current, or by the methods at present in use?

The witness said:

It is not true. If Bell means undulatory currents of the type which he describes, the allegation shows a curious want of knowledge, because the currents actually used in 1870 in cable signalling were well known not to be intermittent currents in the sense in which Bell employs the word, they could not be represented by the square topped diagrams given by Bell as representing intermittent or pulsatory currents, because the induction action of the cable prevents such sudden and abrupt rise and fall of currents, and com-

pels the current to fluctuate or undulate in its passage through the cable. See the diagram of undulatory cable signals in Professor Jenkins' text book on electricity.

In answer to the defendants' seventeenth direct interrogatory which is as follows:

Does the telegraphic transmission "of noises or sounds of any kind" involve any other uses of the instruments shown in Bell's specifications than that of transmitting undulatory currents?

The witness said:

Seeing that noises and sounds, for the most part do not consist of musical tones, or of chords or vowel sounds, it is perfectly clear that to transmit noises and sounds of any kind implies a different mode of using the instruments from that mode employed for the transmission of musical tones, chords and vowels. All sudden disturbances of the air, as for example—such as that produced by clapping the hands together, by firing a pistol, or by shaking a piece of metal, do not consist of recurring undulations, and cannot be represented by undulatory curves. This was perfectly well known for years before 1876, and in many books on acoustics, for example in Professor Tyndall's well known book on Sound, there were given some diagrams on the undulatory curves which correspond to musical sounds, and of irregular curves which correspond to mere noises. The current which is to transmit the mere noise or irregular disturbance of the air cannot possibly be an undulatory current in the sense in which Bell defines such currents.

In answer to the defendants' eighteenth direct interrogatory, which is as follows:

Is there any difference in principle between the receiving part of the instrument shown in fig. 7 of Bell's specification No. 174,465, and the receiving part of Reis's apparatus described by Legat and shown in the plate in Volume IX of the Zeitschrift des D. O. Telegraphen Vereins, 1862? Compare the receiving parts shown in figure 7 with the said apparatus described by Von Legat, member by member, and

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explain fully the grounds of your opinion on the subject embraced by this question?

The witness said:

There is not much difference in the principle of construction between the receiving part of Bell's figure 7, and the receiving part of Reis's apparatus described by Legat, but there is a considerable difference in principle in the purpose for each which was stated to be intended to be used. In respect to difference in construction, there was in each instrument an electro magnet, Bell's had one coil, Reis's had two. This involves no difference in principle. The armature in Bells' apparently consists of a jointed lever; the armature in Reis's consists of a horizontal bar or tube of oval section, supported on a pivoted lever; the armature of Bell's is attached to the center of a membrane or diaphragm, which is in itself elastic and exposes an extended surface to the air, and is therefore eminently suitable for imparting to the air the vibrations of the armature. In Reis's, the armature was attached not to an elastic membrane but to a broad, flat lever, presenting an extended surface to the air and which, whether it was itself elastic or not, was acted upon by an elastic spring. In each instrument we have then three principles, the attraction, electric magnetical of an armature; the elastic mounting of that armature; the employment of an extended surface to communicate vibrations to the air. I observe also that in Legat's description of the instrument, he expressly states that the lever is designed to communicate its vibrations to the surrounding air. Bell's instrument is undoubtedly the simpler and the more effective, but Reis's instrument equally embodies the three foregoing essential principles. Bell's instrument had one point of superiority, it would be more easy to listen with one's ear close to the membrane than close to a projecting lever, but on the other hand, the membrane would be more likely to be affected by moisture than the lever apparatus. With respect to the difference in principle, so far as relates to the purpose for which each was to be used, Legat expressly states that Reis's was intended for the transmission of the voice with

the various inflections as in calling, exclaiming, etc., whereas Bell's specification says nothing whatever, about the transmission of articulate speech by his instrument.

In answer to the defendants' nineteenth direct interrogatory, which is as follows:

Do you consider that articulate speech can be intelligibly transmitted without the intervention of undulations such as are stated by Bell to be essential for operating his alleged invention, and explain fully the reasons for your opinion?

The witness said:

I consider that articulate speech can be intelligibly transmitted without the intervention of undulations such as are stated by Bell to be essential for operating his invention, because it is by no means necessary for understanding speech that the vowels should be precisely reproduced. It is much more important that the consonantal sounds, the rhythm, the transmission of tone, and the various inflections of the voice should be reproduced; this is well known to philologists, who recognise that the vowel sounds vary from one language to another, and from one dialect to another. In words in which the consonants still retain the same form, for example take the English work "right," this is pronounced by the Scotchman "reet," it is pronounced by an Essex man "roight," it is pronounced by many north country men "raaight," and by a great many educated people it is pronounced "rate"; yet with all these variations in vowel sounds the consonants remain the same, and even if the vowels were not distinguishable as to whether it was, "e" or "a" or "i" still the word would be recognised by the consonantal sounds. This is only one instance of many which might be given of the intelligibility of speech depending not on vowels but on consonants; in fact neither vowels nor chords nor musical tones are necessary for the transmission of intelligible speech, and therefore undulations which correspond only to vowels, chords and musical tones cannot possibly be adequate to represent articulate speech.

In answer to the defendants' twentieth direct interrogatory, which is as follows:

Is the knitting needle of Reis's competent to act as a receiver either for articulate speech or for mere vowel sounds? Explain fully the grounds for your opinion on the subject of this question.

The witness said:

Reis's knitting needle is competent to act as a telephonic receiver, both for articulate speech and for musical tones, and also for vowel sounds. I know this because I have often heard speech and vowel sounds reproduced with the utmost clearness in a receiving telephone, constructed by Phillip Reis himself in the year 1861, and which contains a knitting needle. I am aware that in his original paper, published at Frankfort in 1861, Reis stated that the consonantal tones were reproduced by his apparatus, but that the vowels were not equally well transmitted. I attribute this with confidence not to any imperfection in the receiver, but the operation of his transmitter. It is extremely difficult to get a transmitter so loosely set as was that of Reis's to transmit vowel sounds, though it will transmit the abrupt consonantal sounds with fidelity. I therefore see no reason for doubting the entire correctness of Reis, when he said that he could not reproduce vowels with the knitting needle receiver though it would produce consonants.

In answer to the defendants' twenty-first direct interrogatory, which is as follows:

Did you when experimenting prior to 1876 with the Reis instrument recognize what was said in the Reis telephone, by the consonantal sounds or by the rhythm of the syllables and sentences, or by the inflections and intonations and accent of the voice?

The witness said:

In our experiments in 1875 we recognized the words which were spoken, partly by the consonantal sounds, partly by the rhythm of the syllables and words and sentences, and partly also by the inflections and intonations of the voice: for example, we could recognize the words "Hip, hip, hur-

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rah"; partly by the pauses between the words; partly by the characteristic "p's" at the end of the first two words; partly by the rattle of the "r," and partly by the sustained tone of the "ah" at the end of the word. Also in such questions as "How do you do," I am perfectly sure that we recognized what was said, by the transmission of the consonant "d," as well as by the rhythm of the words and the final use of the voice. I think it ought not to be forgotten that a great deal of the intelligibility of ordinary sentences depends upon the rhythm of the words and upon their intonation and accent, far more indeed than upon the accuracy of vowel sounds.

In answer to the defendants' twenty-second direct interrogatory, which is as follows:

Was the announcement of Bell's invention in 1876 the announcement of an art entirely new to you, or were you prior to that announcement acquainted with the art of telephony?

The witness said:

I had supposed in the year 1875 when I was told that Reis's instrument required to be talked to at one end, and to be listened to at the other end, that the art of telephony consisted in arranging the apparatus so that talking might be transmitted in that manner, and I fortified the knowledge of the art of telephony thus imparted to me when I constructed with my brother the experimental apparatus referred to in my previous answer; but the announcement of Bell's invention in 1876 was new to me, in so far as it described the method of transmitting by means of induction, that is to say, by causing the voice to act on an armature attached to the membrane, instead of acting as in Reis's transmitter upon a contract arrangement in a battery circuit; and I also think, looking back at that time, that it was new to me, insofar as it made clear to my understanding the transmission of vowel sounds, which had puzzled me in thinking over Reis's transmitter. With these two reservations I may say that the announcements made in 1876 with

respect to Bell's invention were not the announcement of an art new to me.

In answer to the defendants' twenty-third direct interrogatory, which is as follows:

Were the several Reis publications with which you are familiar, prior to 1876, in your opinion sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus, and how to use the same for the production of musical sounds and articulate speech?

The witness said:

I am familiar with numerous publications made prior to 1876 respecting Reis's invention, and I am of opinion that although some of these are insufficient, there are others which are abundantly sufficient, to have instructed a person of ordinary common sense, to construct an apparatus similar to that of Reis's, and if that person had been instructed that one instrument had to be talked to, while he listened to the other, I am certain that from those observations he could have used the instruments so as to transmit articulate speech and musical sounds. In saying this I would point out, that a considerable number of the earlier publications concerning Reis's telephone were taken from Hesslers' text book of Physics, in which an extremely ignorant and imperfect account of Reis's telephone was given. Hessler did not even know how to spell Reis's name, for he calls him "Reuss," but the description of Legat, both as contained in the journal of the Austro-German Telegraph Union and in the German Encyclopædia of Physics, were quite sufficient to instruct a good workman to make the apparatus; and as a proof of the fact that the apparatus was sufficiently known, there exists an instrument, which I have seen, constructed in 1865 by Mr. Ladd of London, and sold to Mr. Yeates of Dublin, as a Reis telephone, which Mr. Yeates used for the very purpose named in my interrogatory.

In answer to defendants' twenty-fourth direct interrogatory which is as follows:

Have you in your possession a copy of Julius Zoellner's

"Krafte der Natur," (being vol. II of "Das Buch der Erfindungen," published at Leipzig and Berlin in 1876), and if so, produce that book before the commissioner and cause it to be identified, stating how you came into possession of it, and annex to your deposition an accurate copy in the original on pages 347 and 348 of that book, and any other passages relating to the use of the Reis telephone to transmit laughter and sustain conversation; and also annex an English translation of the same, and have the book itself marked, an exhibit in this cause, if you are willing to intrust it to the commissioner.

The witness said:

I produce a copy of the said book, and I hand it to the Court, to have it marked for identification. I purchased it about twelve months ago from a German house, having found previously a copy of it in the library of the British Museum in London. I will furnish the Court before I sign any deposition, with a copy of page 347 and 348 and with an English translation of the same. I am not aware of the existence of any passages other than those on pages 347 and 348 in this book, in which the use of a Reis telephone to transmit laughter and sustain conversation is described; certainly I am not aware of any passage among the publications relating to Reis, which is so striking as the last sentence on page 348, with respect to the limitations of the power of Reis's telephone, for in no other publication relating to Reis is it even suggested that it was an imperfection of the telephone as it existed at that time, that it could not be used to transmit the speech of an orator to several different audiences in several different towns at the same time.

The book produced by the witness was marked for identification as follows "Vol. 2, of Das Buch der Erfindungen, S. D. Oliphant, commissioner, July 10, 1884."

In answer to the defendants' twenty-fifth direct interrogatory which is as follows:

Have you in your possession the original instrument shown by Philip Reis at Frankfort in Germany in 1861 at

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the Physical Society, and if so, when and how did you obtain it, and how long has it been in your possession? If you have a photograph of that instrument, have it identified by the commissioner and annexed to your deposition; or if you are willing to part with the possession of the instrument, have the instrument itself identified by the commissioner and delivered into his custody.

The witness said:

I have in my possession the original instrument shown by Philip Reis at Frankfort in Germany in 1861; it has been in my possession about twelve months; I bought it from Dr. T. S. Stein of Frankfort, who can identify it as the original instrument. I will place a photograph of it in the hands of the Court before signing my deposition.

The instrument and photograph referred to in the last answer were marked for identification as follows:

This instrument is marked "Reis's Frankfort Instrument," the photograph is marked, "Photograph Reis Frankfort Instrument."

In answer to defendants' twenty-sixth direct interrogatory which is as follows:

Do you know or can you set forth any other matter or thing which may be of benefit or advantage to the parties at issue in this cause, or either of them, or that may be material to the subject of this your examination, or the matter in question in this cause? If yea, set forth the same fully and at large in your answer.

The witness said:

I have recently made some experiments which bear upon the question of whether articulate speech, can be transmitted by an apparatus in which the circuit is absolutely made and broken, and I would propose to mention to the Court with the observation, however, that Reis himself never declared that his instrument was to work by make and break. He said it was to work by opening and closing the circuit, and this is not necessarily the same thing as making and breaking the circuit;—he used the word "Unterbrechen,"

which I translate by "Interrupting," rather than "Breaking." Had he meant absolute breaking, I think he would have used the word "Zerbrechen." The former of these words means to break sometimes completely, the latter word means to break absolutely completely, and it is significant that he used the former and not the latter. It is perfectly certain that in using either the apparatus of Reis, or a Blake transmitter, complete interruptions of the circuit do occur, if the transmitter is too loudly spoken to; it is also entirely certain that incomplete or partial interruptions of the circuit are also produced, and it is not absolutely clear from the language of Reis's descriptions what he intended to happen at the place of loose contact in his interrupter. He talked about opening and closing the circuit, but in such a way as leaves very little doubt in my own mind that he intended such opening and closing of the circuit to be proportionable to the vibrations imparted by the voice; and it is clear from the curves with which he illustrated his paper, that he had a most complete and clear understanding of the nature of sound waves such as musical tones and vowel sounds and even of discordant sounds, and I cannot conceive a man who possessed this knowledge stultifying himself by proposing to open and close a circuit in an abrupt manner, when in the same breath he was declaring that the sounds which he proposed to transmit were to be represented by a gradually rising and falling curve. With this observation I would ask the permission of the Court, to mention that I have recently been using a Reis transmitter on a circuit in which I had balanced the self induction of the receiver and of the conducting wires in such a way that no spark could occur between the contact surfaces and the interrupter, even if they were absolutely parted from one another. The result of experimenting under these conditions, showed me that the rattling sounds heard in the receiver when the transmitter is so loosely adjusted that absolute breaks occur, it is not due, as many people have hitherto maintained, to the mere breaking of the circuit, but it is due to the occurrence, at the contact pieces, of a spark due to self induction, and the

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rattle thus heard is the rattle of the spark, for I get no such hard rattle on my balanced circuit, even when the contact is made and broken in the most absolute manner. It may also be pointed out that this harsh rattle is very much less pronounced when carbon electrodes are used, and my recent experiments, furnish an explanation of this, because it is well known, that when a spark occurs beween two carbon surfaces a minute and temporary voltaic arc occurs, which prolongs its discharge and prevents it from being so abrupt in character. On a balanced circuit, articulate speech is extremely well conveyed by a Reis transmitter, even when you talk so loud that the speech is barely recognisable when the circuit is unbalanced. The existence of the extra current spark in Reis's transmitter was noticed so far back as 1865 by professor Mueller who, however, seems to have thought that it did not constitute a defect in the apparatus.

My experience proves then that speech of an intelligible and articulate kind can be reproduced in an instrument which absolutely makes and breaks a circuit, as well as in one which merely opens and closes the circuit, by varying the resistance at some point, provided the circuit is so balanced that no spark can occur.

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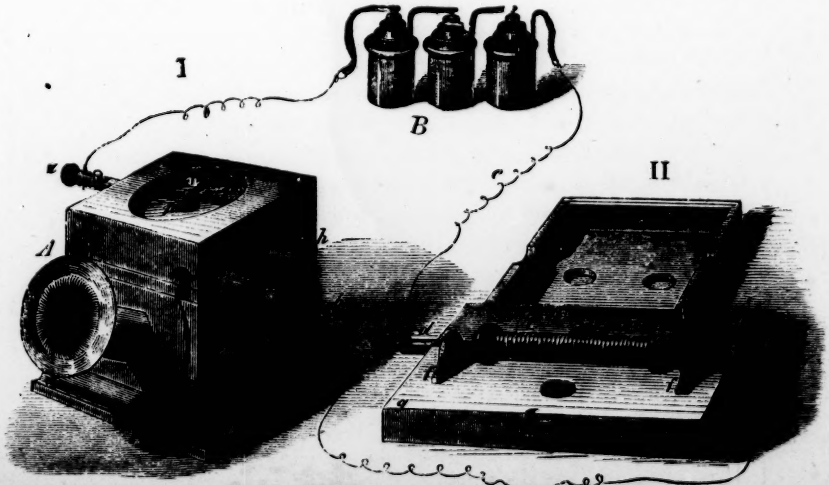
Extract from "Die Krafte der Natur und ihre Benutzung," (The Forces of Nature and their Utilization), by Julius Zollner, Leipzig and Berlin, 1865, being volume II. of "Das Buch der Erfindungen, Gewerbe und Industrien," (The Book of Inventions, Trades and Industries.)

Translation, page 347.

"It sounds more than fantastic, if it is stated that it is possible to converse through the electric telegraph wire to hundreds of miles with a distant person, so that this one shall with his bodily ear perceive our voice with all its peculiarities; that he shall hear the melody which we sing; that if we laugh he shall feel exactly as if he stood beside us, and yet this possibility has already become an actuality, at least so far, that that which is yet incomplete in its performance appears to be merely a technical matter, but which must certainly, with the means at our command, attain the results previously described.

"The head teacher, Reis, in Frankfort-on-the-Main had the good idea to make the electric telegraph, which hitherto was an eye reaching over the continent, into an artificial ear. The electro-magnetic apparatus in this enormous instrument of hearing plays the part of the auditory ossicles which convey the tremors from one membrane to another, and the only difference between the inferior parts of the tympanic cavity and the connecting arrangement of two such stations, consists in this, that the waves beating on the tympanum are in the one case made perceptible by a lever mechanism and in the other by the agitation of an iron rod.



"At the first station I. there is a hollow box provided in

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which is to be made audible at the distant station II. The box has on its upper surface an opening closed with a stiff, strained membrane made out of pig's bladder. Upon this membrane lies a quite fine platinum strip p, and thereupon touches the point of an elastic platinum pin n, which is so placed that it exactly touches the strip p, when the membrane is at rest, but when the latter vibrates to and fro leaves the little plate at every vibration. By this alternate contact and separation is closed and interrupted the electric current, which is conducted from the Bunson's battery (3–4 elements) through the clamping screw a, into the platinum strip p, and from this through the pin n, into the second clamping screw b. From b, the wire goes to the second station, here it runs round the spiral c, c, and goes out from this by the clamping screw d, and back by the wire e, connected with it back to the battery. In the middle of the spiral lies a thin iron wire with its two ends fastened into two bridges f, f, which in turn rest on the sounding board g, g. The parts h, i, k, l, in both stations belong to a telegraph apparatus by which the attention of the distant hearer can be directed to the commencement of the communication.

"The repetition of the tone depends on this, that the little iron rod is set in a tremor every time when it is made magnetic by the electric current whirling round in the spiral. Though the single motion of the smallest particle is so inconsiderable yet it is sufficiently great to produce a regular rapid repetition the sensation of a tone which is re-inforced and made audible by the sounding board. But the succession of transmissions of the current depends on the vibrations of the membrane N, at the first station, and consequently the tone of the reproduction apparatus at the second station must agree exactly in respect of height and depth with the tones sung into the sound opening A.

"Reis has already, in October, 1861, made successful trials with his apparatus, and repeated such before a larger auditory. A melody moderately loudly sung was distinctly repeated by the reproducing apparatus at a distance of 300 feet.

"Since then countless improvements have essentially enhanced the action, so that the problem of 'far-speaking' may be considered in theory as solved, although the interesting apparatuses do not yet possess such a perfection as to make it possible for a speaker to inspire with his words great assemblies simultaneously at as many places on the earth as he pleases, however distant from him, and remote from one another."

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UNITED STATES CIRCUIT COURT.

District of New Jersey.

The American Bell Telephone Company
vs.
The Overland Telephone Company of New Jersey.

In Equity.

St. James' Hotel, 77 Piccadilly,
London, England,
July 17th, 1884.

Answers to cross-interrogatories administered to Sylvanus P. Thompson of Bristol, England, named in the foregoing commission, a witness produced before the commissioner for examination on the part of the defendants in the above stated cause.

The witness (having conscientious scruples against taking an oath) was at his own request affirmed as to the complainants' cross-interrogatories, as follows:

I, Sylvanus Phillip Thompson, being a member of the Society of Friends, commonly called Quakers, do hereby solemnly, truly and sincerely affirm and declare that the answers I shall make to the interrogatories propounded to me by the complainant in this case shall be the truth, the whole truth, and nothing but the truth, and to this I solemnly affirm.

In answer to the complainants' first cross-interrogatory, which is as follows:

Are you not the author of a book entitled Elementary Lessons in Electricity and Magnetism, by Sylvanus P. Thompson, B.A., 1881, and are you not the author of the fifth edition of that book, published in London by Macmellan & Co. in 1884, and annex copies of the two editions to your depositions?

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The witness said:

I am the author of the book entitled "Elementary Lessons in Electricity and Magnetism," published in 1881 by Macmellan & Co., and of the fifth edition of the same published in 1884. I will furnish the Court with a copy of the latter edition, but I regret to say the former is out of print; otherwise I should have been happy to have placed a copy at the disposal of the Court.

The book produced in answer to this cross-interrogatory is marked by the commissioner "Defendants' exhibit, Sylvanus P. Thompson, edition of 1884, S. D. O. Commission, July 17th, 1884."

In answer to complainants' second cross-interrogatory, which is as follows:

Assuming that you will swear in reply to twenty-third interrogatory that the "several Reis publications with which you were familiar prior to 1876" were sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus and how to use the same for the production of articulate speech, will you explain to the Court why you did not know that in 1881 when you published the 435th paragraph, page 400, in your book on Electricity and Magnetism, that "in 1876 Graham Bell invented the articulating telephone," and why in the index of that book you say, "Telephone, Graham Bell's (articulating)"; and why in that same book, in the 434th paragraph, you described Reis's telephone in the manner which you did?

The witness said:

I am asked why I did not know in 1881 that the Reis publications with which I was familiar prior to 1876 was sufficient to have instructed a person skilled in the art of telephony how to construct an apparatus, and how to use the same for the production of articulate speech; and I am also asked why I did not know in 1881 that in 1876 Graham Bell invented the articulating telephone. I am also asked why in the index of that book I gave the reference "telephone, Graham Bell's articulating."

I reply—in 1881, though I was familiar with a number of

publications relating to Reis's telephone, there was one which I consider especially sufficient to have instructed a person; which publication at that time I attributed not to Reis, but to Legat, though I know now that it is really a description of Reis's invention and not Legat's. I fear that my ignorance in and prior to 1881, that this invention, attributed by me at that time to Legat, was in reality due to Reis, has caused me on many occasions not to do justice to Reis's real claim, and for that very reason I have been the more anxious, since it came to my knowledge that Reis and not Legat was the inventor of that form of articulate telephone, to make amends for the injustice which I have unwillingly done to Reis.

With respect to the question why I did not know in 1881 that in 1876 Graham Bell invented the articulating telephone, there must be some mistake in the interrogatory, because I was perfectly aware in 1881 that in 1876 Graham Bell had invented an instrument, which he particularly informed the world was his invention, and which he denominated "The Articulating Telephone." Every inventor has a right to put a name on his invention, for example Reis called his invention *The* Telephone, Edison called his invention "The Carbon Telephone," Hopkins has called his invention "The Long-Speaking Telephone," and Graham Bell has called his "The Articulating Telephone." I hope I am too wise to quarrel about words, although I am of opinion that in many cases inventors did not christen their instruments until long after they had been, of which fact I believe both Graham Bell's specification No. 171,465, and Edison's first telephone specification bear witness, for the one does not call the invention "The Articulating Telephone," nor even a "Telephone" at all, and the other names neither Carbon nor Telephone. I described Reis's telephone in the first edition of my "Lessons" as an imperfect telephone, and so it is. Reis himself admitted it, and said it would not transmit the vowels, but the fact that an instrument is confessedly imperfect does not prevent it from being an invention.

In answer to the complainants' third cross-interrogatory, which is as follows:

Between the date of the first edition of your book and the fifth, did you not take out two British patents; the first numbered 2,578, dated May 31, 1882, and the second numbered 3,803, dated August 9, 1883?

The witness said:

I did take out two British patents in the inverval named; in fact, I think I took out more than two.

In answer to the complainants' fourth cross-interrogatory, which is as follows;

Since the publication of your first edition, have you not become associated as consulting electrician for the "London and Globe Telephone and Construction Co," a corporation working in opposition to the United Telephone Company, representing the inventions of Graham Bell in England, and does not your name appear in the advertisements of that company as one of its officers?

The witness said:

I have acted as consulting electrician to the London and Globe Telephone and Maintenance Company (that is the proper name of the company), and I believe my name has appeared in the prospectus of that company in the capacity of consulting electrician. That was my sole connection with this company. I have had nothing to do with its commercial operations, and have confined myself to scientific matters. I have never been a director of that or any other telephone company, neither at the time of the formation of the company nor when writing my book entitled, "Philipp Reis, inventor of the Telephone," did I hold or had I held any shares in the company. I had no pecuniary interest in it whatsoever; my connection was purely that of a consulting professional man engaged on professional terms to advise in scientific matters. Since I wrote my book I have become a shareholder in the London and Globe Telephone Comany to the amount of £250 nominal value taken at par, having had 250 shares assigned to me by a

former shareholder in the company as payment of a cash debt.

In answer to complainants' fifth cross-interrogatory, which is as follows:

Were you not a witness for the defendant in the case of the "United Telephone Company, limited," against Harrison, Cox, Walker & Co., in the High Court of Justice Chancery Division, in which judgment was delivered May 10th, 1882?

I was a witness for the defendants in the case of the United Telephone Company vs. Harrison, Cox, Walker & company.

In answer to the complainants' sixth cross-interrogatory, which is as follows:

In that case did you not testify as is reported in the "Electrical Review" (London), May 20th, 1882, and as follows:

Professor Thompson considered that the change in the "Resistance, which took place in carbon under pressure, was due to surface contact only. His own experiments proved this. The pressure only increased the area of the surface contact. Reis's transmitter was intended by the inventor to work as a make-and-break contact instrument, and the inventor expected to produce articulate speech by this action. As a matter of fact, Reis did obtain articulate sounds, but this was when the instrument worked in a manner which it was not intended it should. Professor Thompson was not aware that, prior to Bell's patent, anybody had written to the effect that Reis's transmitter acted in any other way than as a make-and-break instrument.

"The witness had himself heard a Reis instrument transmit articulate speech," and did you not testify to the same effect?

The witness said:

I testified at considerable length in that case, and my evidence was taken down verbatim at the time, and is printed in the records of the case. I do not admit the accuracy of the paragraphs quoted from the "Electrical Review," which will not by any means represent fairly what I said, and do

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not pretend to be verbatim quotations. I think it may assist the Court if I explain the drift of my evidence in that case. I endeavored to put before the High Court of Chancery my view, as a scientific man, that the action in a battery transmitter was due to changes in contact, and not directly to changes in pressure; and I also hold that these changes of contact were due to minute makes and breaks, between the thousands of particles, at the two separating surfaces. I held, and still hold, that all that pressure can do at a so-called microphonic contact, is to increase or diminish the number of particles of the one surface that may be in contact with the particles of the other surface, and that, therefore, it is strictly true to say that the effect of talking to a microphonic or a loose contact, is to open and close the circuit more or less, seeing that the resistance will depend upon the number of molecules which touch one another and form bridges by which the electric current can pass from one of the contact pieces to the other, and I say that it is a matter of clear inference, from Reis's own publications, that he intended his transmitter to act as a contact instrument—to open and close the circuit, strictly in proportion to the vibration, not necessarily breaking completely or making completely the circuit at any instant; and I think it is quite clear that Reis intended to produce articulate speech by this operation, which he did not call make-and-break, but which he called opening and closing the circuit, and which he also called interrupting the current; and further, I am distinctly of opinion that all our modern carbon transmitters and microphones do nothing more than this—they open and close the circuit in proportion to the vibration. As to the alleged quotation about the instrument having worked in a manner in which it was not intended that it should, I think that this garbled extract is intended to refer to a question put to me in cross-examination in the Chancery Court by Mr. Ashton, who wished to make it appear to the Court that because articulate speech is best transmitted by Reis's transmitter when talked to in a low tone and not in a loud tone, that, therefore, by talking to

the transmitter in a low tone I was not using a transmitter in the sense that Reis intended it to be used. Now it is remarkable that in almost all the early accounts published about Reis's transmitter, the remark is made that it was sung or spoken to in a moderate and not in a loud voice. I therefore think that there is no ground for the insinuation that talking to the transmitter in low tones instead of loud ones is using the instrument in a manner in which it was not intended it should be used. It is true that on that occasion I testified that I had myself heard a Reis instrument transmit articulate speech. I have often so heard it both in 1876 and 1884.

In answer to the complainants' seventh cross-interrogatory, which is as follows:

Are you not the author of a book entitled "Philipp Reis, inventor of the Telephone," by Sylvanus P. Thompson, B.A., London, 1883?

The witness said:

I am the author; I wrote every word of it, except the documents and letters which are printed with names attached to them.

In answer to the complainants' eighth cross-interrogatory, which is as follows:

In that book, page 41, you say "As far as Professor Dolbear is concerned, therefore, he admits, in unequivocal terms, the whole claim of Reis to be the inventor of the telephone." Did you not know when you published that statement that Professor Dolbear was interested in the defense of a suit in the United States, in which the American Bell Telephone Company was complainant and Dolbear and others were defendants, in which the defense was in part founded upon the assertion that Philipp Reis was the inventor of the telephone, and in which the inventions of Philipp Reis were used to limit the scope of Bell's patent?

The witness said:

I had heard that there was some litigation going on in this case between Professor Dolbear and the American Bell Telephone Company, and I was also aware that Pro-

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fessor Dolbear was a scientific man of great eminence, and that his opinion on such matters was of great weight.

In answer to the complainants' ninth cross-interrogatory, which is as follows:

Did you not know that Albert Stretson, named in the preface of that book, was the agent of or employed by Professor Dolbear, or the defendant in that case, to collect the evidence of Reis's invention, for the purpose of maintaining that defense, and did not you consult with and assist said Stretson in his effort in that direction?

The witness said:

I was aware that Mr. Albert Stretson was in the employ of Professor Dolbear. I was aware that he was collecting evidence as to the nature of Reis's invention, and on several occasions, I exchanged references with Mr. Stretson as to the sources from which reliable information could be gleaned as to the early invention of Reis, and the names of those persons who in the years 1863 and 1864 and 1865, saw Reis's telephone and heard it talk. I shall be very happy to furnish the Court with the names and addresses of a large number of individuals, some of whom I heard of through Mr. Stretson, and others Mr. Stretson heard of through me.

In answer to the complainants' tenth cross-interrogatory which is as follows:

Who besides yourself contributed money to the publication of the book and the procuring of the information contained in it, entitled "Philipp Reis, inventor of the Telephone?"

The witness said:

No one as far as I am aware contributed any money to the publication of the book, nor did I myself. It was published as a purely business undertaking by Messrs. E. and F. A. Spon who published it at their own risk, without asking or receiving any guarantee or payment or promise from myself or any other person. They published it in the ordinary way of business, just as they have since published my lectures on dynamo electric machines. As to the procuring of the many details of valuable historical information contained in

that book, those details have been the result of some years' investigation on my part, and of several visits to the Continent, two of which were visits of pleasure made some years ago, in the course of which, I devoted a little time to the picking up scientific information and books on electrical subjects including Reis's telephone. For example in 1876, when spending some weeks at Heidelberg I picked up a copy of Pisco's book of acoustics, which contained an admirable account of Reis's invention and a copy of Reis's prospectus. On one occasion when I went more particularly for the purpose of visiting Frankfort to ascertain what might be found out concerning the exhibition of Reis's telephone, my expenses were paid by the London & Globe Telephone and Maintenance Company; besides this I have received information respecting Reis's telephone and its various performances in the years 1863, 1864 and 1865 from a great many different and independent sources, from German professors, scientific friends and acquaintances, for which no money whatever has been contributed. The greater part of my information was picked up in the course of ordinary scientific work of professor of physics.

In answer to the complainants' eleventh cross-interrogatory which is as follows:

Do you not know that that information was procured in part, at least, by persons acting for the defendants who were defending against the Bell patent in the United States, and that one object of the publication was to discredit Professor Bell as the inventor of the articulating telephone?

The witness said:

I am not aware that any information in my book was procured in order to discredit Professor Bell as being the inventor of that particular kind of instrument which he calls the articulating telephone, and so far as by far the greatest part of the information in my books is concerned, it was not procured by persons who were acting for, or in any way interested on behalf of Professor Dolbear or any other defendants who were defending against Bell's patent in the United States. I have already said that I was aware that Mr. Stret-

son was in the employ of Professor Dolbear, but the information which I received from Mr. Stretson forms a very small part of the facts contained in my book. For example, of the entire list of authorities and documents printed on page 180 of my book, there is only one of which I derived the knowledge of Mr. Stretson, viz.: "Polytechnisches central blatt," and it is probably the least important of any of the whole lot. Indeed I think I gave very much more information to Mr. Stretson than he gave me.

In answer to the complainants' twelfth cross-interrogatory, which is as follows:

Does the paragraph entitled "Third form, the Electro-magnet Receiver," on the 30th page of that book, contain a true statement of the operation of the electro-magnet receiver of Reis, a diagram of which is found on the 32d page?

The witness said:

I presume the paragraph referred to is as follows: "The electro-magnet form is, however, of great importance, because its principle is a complete and perfect anticipation of that of the later receivers of Yeates, of Grey and of Bell, who, like Reis, employed as receiver an electro-magnet, the function of which was to draw an elastically mounted armature backwards and forwards, and so to throw it into vibrations corresponding to those imparted to the transmitting apparatus. Fig. 21 shows the disposition of the electro-magnet and of its vibratory armature upon the sounding board. This apparatus was a good deal larger than most of Reis's instruments. The sounding board was nearly a foot long. The coils of the electro-magnet were six inches long and over an inch thick. The armature, a rod of iron of elliptical section, was affixed crosswise at the end of a 'light and broad' vertical lever, about seven inches long, which seems to have been made of wood, as in Legat's report it is also denominated as a 'plank,'" and I believe that it contains a true statement of the operations of the instrument. The only suggestion that I have to offer as to how the statement might be improved, is to point out that in addition to what

I have said of its action, Legat adds the suggestion that it should be placed at one focus of an elliptical cavity (apparently a sort of mouth-piece), at the other focus of which the hearer was to place his ear. With that exception I do not think I could improve the description.

In answer to the complainants' thirteenth cross-interrogatory, which is as follows:

In the apparatus described by you in your two patents for the transmission of articulate speech, is not the method of that transmission by causing electrical undulations similar in form to the vibrations of the air accompanying the vocal sounds uttered to the transmitter; or, in the language of Sir William Thompson, does not the "strength of the electrical current vary continuously and as nearly as may be in simple proportion to the velocity of a particle of air engaged in constituting the sounds," when your apparatus works to transmit articulate speech?

The witness said:

I think the action of my apparatus would be described equally well or perhaps better by saying that it contains a contact mechanism, the object of which was to open and close the circuit in proportion to the vibrations imparted by the voice. My apparatus does not work, nor does any battery transmitter, whether a Reis or Edison or Blake, or any other, by varying the current in proportion to the velocity of the air particles which constitute the sounds, because, as a matter of fact, the change of resistance at the point of contact is proportioned, not to the velocity which the tympanum may have at any moment, but is proportioned to the displacement of the tympanum. To make this more clear, it may be explained that when employing Graham Bell's method of transmitting by magneto-electric induction, it is strictly true that the strength of the induced current will vary continuously, and very nearly in proportion to the velocity of the air particles and of the tympanum. Induction in a magnetic field is always proportioned to the velocity, not to the displacement of the moving body; but the

contrary is the case when using a battery transmitter, such as that of Reis, Edison or Blake.

In answer to the complainants' fourteenth cross-interrogatory, which is as follows:

If you deny this, will you explain to the Court what you understand to be the relation between the current on the line wire and the movement of the particles of air, when your apparatus speaks?

The witness said:

I will endeavor to explain the operation of my apparatus, but the explanation equally applies to any ordinary battery transmitter. When the particles of the air are urged to and fro by a simple undulating movement, such as is described by Graham Bell, and such also as corresponds to a simple harmonic wave form, the particles in their oscillations move most quickly when they are at the middle of their path—that is to say, when they are in such a position that they are not displaced, either forward or backward, and their velocity becomes a minimum when their displacement, forward or backward, is at its greatest extent. The pressure which these air particles exercise upon the tympanum, if there is one, or upon the contact pieces, in case the air waves impinge directly upon the contact pieces, without the intervention of a tympanum, is proportional to the displacement of air particles, not to their velocity; and since the strength of the current is proportional to the pressure on the tympanum, or nearly so, it follows that the strength of the current is proportional to the displacement of the air particles, and is not proportional to their velocity—the current being greatest when the tympanum is pushed forward by the air wave to its extremest position and when the velocity has momentarily come to zero. Of course, I do not imply here that the pressure of the tympanum can itself directly do anything—for, as I explained previously, as I understand the matter, all that pressure does is to alter the number of particles which are in contact with one another in the surfaces.

In answer to the complainants' fifteenth cross-interrogatory, which is as follows:

Has any apparatus of yours, patented or otherwise, been used by any persons or corporations in Great Britain who are not licensed under the inventions of Bell or Edison?

The witness said:

I am not aware that any telephonic apparatus of mine, patented or otherwise, has been used by any corporation in Great Britain, or by any person or persons in Great Britain, otherwise than experimentally.

The last interrogatory being propounded to the witness, he stated that he had nothing to add to his answers previously given thereto, and which is to be found at the close of the direct interrogatories.

(Signature.)

(Jurat.)

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UNITED STATES CIRCUIT COURT.

DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY
vs.
THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, ET AL.

In Equity.

UNITED STATES CIRCUIT COURT.

EASTERN DISTRICT OF PENNSYLVANIA.

THE AMERICAN BELL TELEPHONE COMPANY,
Complainant.
vs.
THE PENN OVERLAND TELEPHONE AND TELEGRAPH COMPANY et al,
Defendants.

UNITED STATES CIRCUIT COURT.

SOUTHERN DISTRICT OF NEW YORK.

THE AMERICAN BELL TELEPHONE COMPANY
vs.
THE OVERLAND TELEPHONE COMPANY, AND OTHERS.

Evidence taken for the defendants in the above three cases in pursuance of a stipulation under the 67th rule of the Supreme Court of the United States, in equity, as ammended; at No. 721 Broad street, Newark, N. J., before Corra N. Williams, Notary Public.

PRESENT:

E. N. DICKERSON, Esq., Counsel for Complainant.
A. Q. KEASBEY, Esq., Counsel for Defendants.

Henry E. Waite, a witness sworn on behalf of the defendants, testifies as follows:

Examined by Mr. Keasbey:

Int. 1. Give your age, residence and occupation?

Ans. I am thirty-eight years old; residence, New York City; my occupation, manufacturing electrician, 204 East 23d street.

Int. 2. How long have you been engaged in subjects relating to electricity?

Ans. Since 1879.

Int. 3. Have you made yourself familiar practically with the subject of the speaking telephone, and with the literature on that subject?

Ans. I have.

Int. 4. Have you been engaged in the practical construction of various telephonic instruments for commercial uses, as well as for experiments and investigations in legal proceedings?

Ans. I have.

Int. 5. Have you examined and do you understand the patent issued to Alexander Graham Bell, No. 174,465?

Ans. Yes, sir.

Int. 6. Calling your attention to that patent, particularly to the fifth claim thereof, what do you understand to be the method and process described in said patent, and referred to in said fifth claim, taking into consideration the drawing figure?

Ans. I should understand from the description given in the patent, that it was another apparatus for transmitting sounds telegraphically, for telegraphic purposes, and not as a telephone for transmitting articulate speech.

Int. 7. Do you find in the Bell patent, No. 174,465, any information of the discovery of the art of transmitting speech, or any statement of the existence of such art?

Ans. I do not.

Int. 8. Do you find therein a description of any appa-

ratus, the design and purposes of which are stated to be the transmission of articulate speech?

Ans. I do not.

Int. 9. In the Bell apparatus described in that patent has the voltaic current any other function than that of magnetizing the electro-magnets?

Ans. It has not.

Int. 10. Has it any function in the transmission of speech?

Ans. None, whatever; only as to make the electro-magnets.

Int. 11. In patent No. 174,465, in figure 7 as there shown, may the electro-magnets be replaced by permanent magnets, and the same effects be produced?

Ans. They may; better effects produced.

Int. 12. Referring to the distinction stated in patent No. 174,465, between undulatory and pulsatory currents; do you understand that there is any practical difference between pulsatory and undulatory currents for the purposes described in the patent?

Ans. I do not; I understand from his description that there is a distinction but I fail to see where it exists.

Int. 13. Have you, yourself, made an instrument in accordance with figure 7, of that patent?

Ans. I have made several of them.

Int. 14. Were they made in exact accordance with that description?

Ans. They were made in exact accordance, with the exception that I arranged them so they could be adjusted, which is not shown or even spoken of in the patent.

Int. 15. Have you been able to use the instruments so reproduced successfully for the purpose of transmission of speech?

Ans. I have not.

Int. 16. Are such instruments used, or have they ever been used commercially to your knowledge as speaking telephones?

Ans. They have not, commercially or otherwise. They

will not transmit speech made according to the drawings of that patent.

Int. 17. Have you read and do you understand the several publications with respect to the Reis telephone?

Ans. I have, and do understand the publications or descriptions.

Int. 18. Have you seen the article published in the book of inventions published at Liepsic and Berlin, in 1865, now handed to you, and being marked an exhibit in this cause, as volume 2 of Das book Erfindungen?

Ans. I have not seen the original book before, but have read the translation put in evidence. On now looking at it, on page 348, I find the drawing of the Reis telephone, called the cube block transmitter and knitting needle receiver, connected and showing the relations to each other.

Int. 19. How does that compare with other forms of that particular instrument which you have seen in other Reis publications?

Ans. It is the same substantially as all the publications which I have seen relating to this particular instrument.

Int. 20. How does it compare with the instrument found on page 86 of Professor Sylvanus P. Thompson's book?

Ans. It is the same.

Int. 21. How does that drawing compare with the drawing of that instrument in Mr. Prescott's recent edition (1884) entitled, Bell's Electrical Telephone?

Ans. It is the same with the exception that the call key is not on the side of the transmitter, and the additional sounding box is not on the receiver; otherwise the connection is the same.

Int. 22. Have you made instruments in accordance with those drawings?

Ans. I have.

Int. 23. In exact accordance with them?

Ans. In exact accordance with them.

Int. 24. Have you experimented with an instrument or telephone made in accordance with those drawings?

Ans. I have.

Int. 25. And with what results?

Ans. I have experimented; at times I got words very faintly, and other times it was a just confusion of sounds.

Int. 26. Have you made any modifications of that instrument, and if so, state what they were?

Ans. I have. I replaced the platinum point with carbon, and have then been able to transmit speech very well.

Int. 27. With that single modification?

Ans. With that single modification.

Int. 28. Have you seen the Reis instrument which is in the Smithsonian Institute in Washington?

Ans. I have.

Int. 29. How does that compare with the instrument on page 348 of the book of inventions?

Ans. It is the same.

Int. 30. What experiments have you made with that instrument?

Ans. I have talked with that instrument. The first experiment I made after finding it, was to talk through that instrument with the Bell telephone receiver. We had in circuit a very weak Leclanche battery, and transmitted speech so that it could be understood perfectly. At that time we had not found the receiver of this instrument. We found only the transmitter. I had difficulty in finding the instrument. I was informed that there was such an instrument there. I went to the Smithsonian and made inquires of the chief clerk. He told me there was no such instrument in the institution; and I insisted that there was, and after some little time he sent a gentleman with me to the electrician, and we together examined the case and found this transmitter. We then took it to his room, and connected up with a receiver by running wires out on the platform from his room to the National Museum, and then we were able to transmit speech perfectly at that time.

Int. 31. When was it you made that examination of the Smithsonian instrument?

Ans. It was, I think, some time in May, 1881; I have the exact dates and can give them, if required.

Int. 32. Was it after the time you made the instruments you have referred to from the Reis diagrams?

Ans. Yes, sir.

Int. 33. When did you make them?

Ans. I made quite a number of them a year ago; a little over a year ago. I suppose I made somewhere perhaps forty instruments, or more, of various kinds; about fifty. I made the cube and needle receiver; I made the Legat transmitter and the Legat receiver, and from those I had the best results.

Int. 34. For what purpose did you make these instruments?

Ans. To determine whether they would talk or not. The Legat instruments I made from the description furnished by the patent office, Legat's drawings and descriptions. The translation was the translation that the patent office furnished at that time.

Int. 35. Were they made from the drawings contained in the publications concerning Reis, which have been put in evidence in these cases?

Ans. I think the book that I saw it in is the one that was in the congressional library. It was published in 1862. I have a copy of the translation, but haven't it here with me. It is substantially the same as those published in all the works of Legat, showing the figure of one-third size.

Int. 36. I show you the Polytechnic Journal, published at Augsburgh, in 1863, by Dr. Dringler, which contains the Legat reproduction, there called Figure 14 and 15; did you make instruments in accordance with those drawings?

Ans. Yes, sir; the drawings are identical.

Int. 37. Have you those instruments in your possession?

Ans. I have.

Int. 38. Did you try those instruments for the purpose of transmitting speech?

Ans. I did.

Int. 39. How did they operate?

Ans. With the instrument built and simply constructed

as described, I was able to transmit words clearly and distinctly, and some sentences.

Int. 40. Have you tried the separate parts of that instrument, the receiver for instance, with other transmitters?

Ans. I have tried a receiver, a commercial receiver, used with the modern battery transmitter.

Int. 41. What do you mean by commercial receiver?

Ans. I mean one on which you can receive, talk commercially and answer it, and understand perfectly everything that you say.

Int. 42. How does that receiver differ in construction from the receivers in ordinary use?

Ans. It differs only in construction. The essential parts are there, as the electro-magnet, armature in front of, not quite touching, with extention extending up or lever made of wood. It is held in its place by a screw and a spring, to hold it in proper tension, so that it can be adjusted close to the poles without touching. The essential parts of the modern receiver are there.

Int. 43. Have you examined the instruments made by Professor Van Der Weyde in 1869, and which have been exhibited in these cases, photographs of which are found in the defendants' papers on the motion for preliminary injunction?

Ans. I have made reproductions from the originals.

Int. 44. Have you had those instruments in your possession for careful examination?

Ans. I have, and now have a number of the reproductions.

Int. 45. Have you examined the instruments known as Van Der Weyde transmitter No. 1; Van Der Weyde transmitter No. 2, and reproduced Van Der Weyde transmitter No. 2?

Ans. I have.

Int. 46. And Van Der Veyde receiver No. 1?

Ans. I have.

Int. 47. State in detail the experiments that you have

made with any instruments constructed similarly to those of the Van Der Weyde instruments?

Ans. I have made experiments with the Van Der Weyde instruments complete. The transmitters are both constructed on the same principle; one is a wooden box, after the Reis pattern somewhat, with spouts to talk through, or speaking trumpet, and the electrodes are different from the Reis. All of the electrodes are held in place by an adjusting screw, so that they can be adjusted from the contact and remain so. The one I made of a tin box has a diaphragm made of rubber, which was stretched across the membrane. His receivers—there were three—one in which he had a number of needles, improving on the needle receiver of Reis; the second was an electro-magnet, with the Reis diaphragm, and iron armature soldered to the center; and the third is the one which he made in 1870, and has an iron diaphragm and horse shoe magnet. I have been able to reproduce speech or transmit speech in both these transmitters and the two receivers containing diaphragms. The results were about the same as I got from the Reis-Legat.

Int. 48. You have stated that with a simple modification by using a hard carbon point on the Reis instrument it will transmit speech fairly well. Was hard carbon as now used in electrical contrivances known at the time of the Reis publications?

Ans. It was not.

Int. 49. Was it known at the date of the Bell patent, March 7th, 1876?

Ans. Not to the fineness which is now used. It was brought in use by the electric light companies in producing fine carbons for electric lights.

Int. 50. Was the substitution of such a carbon point for the platinum point of Reis one that would be suggested by mechanical skill of a person acquainted with the subject, when such a substance as the hard carbon now used came into general employ?

Ans. It would, for the very reason that platinum was used and because it does not oxidize. Carbons which were

used at the time of the Reis instruments were generally of cut carbon, or made of very poor material, and is not as good as platinum for that purpose. Another thing, they had no way of reducing it to small pieces where it could be used, but all crumbles to pieces. I know this from the fact that I had some old carbons when I was experimenting on the transmitters, and tried them, and found that the results were very poor indeed. It is a well known fact that the harder the carbon the better the results, and has been perfectly demonstrated in the Blake transmitter now used.

Int. 51. Why was the platinum point employed at the time of the Reis publications for contact?

Ans. For the same reason that platinum is now used for all electrical contacts, that is in telegraphic cases, etc. That is, it does not oxidize.

Int. 52. Was there any carbon point, or any carbon in any form, employed in Bell's patent of 1876?

Ans. No.

Int. 53. Any occasion for the use of any such point?

Ans. No occasion for it.

Int. 54. Have you examined and are you familiar with the instruments offered in evidence in the Molecular case, known as the Holcomb instruments?

Ans. I am.

Int. 55. Please contrast exhibit Holcomb telephone with the instrument described in the patent of Mr. Bell, No. 174,465, particularly in the fifth claim of said patent, as shown in Figure 7, and state whether, in your opinion, the functions and mode of operation in the receiving instruments are the same or otherwise, and in what respect they are different?

Ans. The mode of operation would be the same, with the exception that you would get results from the Holcomb instrument and none from the Bell instrument.

Int. 56. Have you made experiments with the Holcomb instrument?

Ans. I have.

Int. 57. State in detail the nature and results of those experiments?

Ans. I made two instruments after the pattern of the Holcomb, and connected them up and talked from one to the other. I was able to hear words and sentences, but they were very muffled, owing to the form of the air chamber and the construction of the instrument—a kind of a heavy, muffled sound.

Int. 58. Did they actually transmit speech?

Ans. They did.

Int. 59. Have you those instruments now in your possession?

A. I have.

Int. 60. Taking the descriptions of the Reis instrument with the drawings as described in the publications of and concerning Reis, including that which is given in the book of inventions, to which you have referred; and taking all that is found in Bell's patent of 1876, which, in your opinion, would have furnished the best suggestion to a person acquainted practically with electrical matters at the date of Bell's patent, to construct a telephone for the transmission of speech?

Ans. Bell's patent I should have taken as an instrument for telegraphing or sending telegraphic sounds. There is no description in that patent which would lead me, or any one else, I think, to even suppose that it was ever intended for the transmitting articulate speech. On the other hand, the various descriptions of Reis distinctly say that it was made and used and did transmit speech, and was made for that purpose and none other.

Int. 61. Adding to the Reis publications and the drawings contained in them, the actual instruments made in 1869 by Prof. Van Der Weyde with the metallic diaphragm and and the modifications made by him, would they, in your opinion, with the aid of the Reis publications, have enabled any one skilled in the art to construct an instrument for the practical transmission of speech?

Ans. They would.

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Int. 62. And do you know as a practical man that the instruments described by Reis in their different forms, and the instruments made in this country by Van Der Weyde from the descriptions of Reis, will now actually transmit speech, with more or less perfection?

Ans. They will.

Int. 63. Which will do it better in your opinion?

Ans. Well, the Legat-Reis instruments complete, and the Van Der Weyde are the best of them. The Legat-Reis receiver and the cube transmitter work very nicely. One of the great troubles has been with those who experiment with the Reis instrument, they put on too strong a battery, which has a tendency to alter the loose contact; that is, in the attraction of the current, positive or negative, the real contact is the same, the same as the north and south poles, and you would have to talk very lightly if you would be heard.

Int. 64. Are you familiar with the MacDonough transmitters?

Ans. I am.

Int. 65. Have you made experiments with them?

Ans. I have constructed two sets of the MacDonough transmitters, and from both of which I was able to transmit speech without any difficulty whatever.

Int. 66. State the form of the instruments and the manner of their construction you refer to?

Ans. The transmitter was a stretched membrane stretched over a brass rim of about four inches in diameter, and through the center of which a little bolt passed, and was fastened there with nuts; slipping over this bolt was a bridge, the two ends of which rested on two contacts which were glued to the diaphragm. Upon these contacts the wires went to the battery and to the receiver. The receiver was a brass rim with a membrane stretched in the same manner, in front of which was an electro-magnet; near it, but not quite touching the diaphragm, was glued an armature, and which were connected with suitable wires and

batteries. They were made from the drawings of the patent issued to him from the patent office.

I might further state that the MacDonough transmitter is one of the loose contact kind on the same principle as constructed by Reis with the cube block transmitter, and, in fact, is the principle on which all transmitters that are in use at the present time are constructed; that is, with a loose contact, all being a modification of Reis.

Int. 67. What is the essential element of all these transmitters?

Ans. Loose contact; without loose contact you could get nothing; there would be no variation or disturbance of the current.

Int. 68. In what single point do loose contact transmitters, now commonly in use, differ from the original Reis instrument, as you find it in the cubical box form in his publications?

Ans. There is no difference whatever, only in the form of construction or in the form of the material.

Int. 69. What difference in material is there that adds to the efficiency of the modern transmitters?

Ans. Carbon.

Int. 70. Is there anything in the modern form of transmitters now in use, beyond that of the substitution of the hard carbon point lately come into use, which distinguishes them from the original Reis form of transmitting telephone?

Ans. None, whatever. The cubical box has a gravity loose contact, and is held in place by gravity. The Legat-Reis transmitter is held in contact by a light spring, and is, in comparison with the Blake transmitter, and many other transmitters which have since been patented.

Int. 71. If the Reis instruments operated, as Reis supposed, by such minute makes and breaks of the circuit as conform to the variation in the sound waves, how must the modern transmitter now used operate?

Ans. Well, when they get results which Reis claimed—that is, that he heard speech—they must operate indentically.

Reis stated that at each vibration in the air wave at the transmitter, there would be produced at the receiving end the same vibration.

Int. 72. You say that these transmitters would produce speech perfectly?

Ans. If there was a make and break, or it could be broken so rapidly that it would amount to being continuous.

I have noticed in my experiments with the Reis instruments that the atmosphere seemed to have considerable to do with transmitting speech. Some days it would work much better than others; I have laid that to the atmosphere. Sometimes it happened to oxidize the electrodes, and if Reis was experimenting continually, he must have had spells of as good luck as I had. Some days I have used the transmitter much better than others—simply the difference in the atmosphere.

Int. 73. Have you examined and do you understand the instrument used by the defendants, known as the Baxter instrument?

Ans. I have.

Int. 74. Please look at the instrument now produced, marked Exhibit Baxter instrument, for defendants, January 13th, and state the mode of its operation, and contrast it with the Reis transmitter and the instruments now in common use.

Ans. In the Baxter transmitter I find the loose contact used in all transmitters. I find that there is an iron diaphragm, through the center of which is a platinum point; resting on the platinum point by gravity, in its normal condition, is a bar which holds a carbon disk in contact with the platinum point. I find also a magnet. On the lower end of the bar under the diaphragm is an electro-magnet, through which the current passes when the instrument is in use—which causes it to act as a spring, which brings the parts in more forcible contact. This magnet takes the place of the spring which you will find in the Legat transmitter of Reis.

The operation of the instrument, and arrangement is the

same as other transmitters now in use, having the coil, the primary of which passes through the coil which makes the electro-magnet under the bar acts as a spring, and passing through the diaphragm to the carbon electrode, and from there through a wire around through the hinges and back to the primary.

When you speak in front of this transmitter the current is varied or interrupted, or disturbed, whichever it may be, which causes a secondary current in the secondary coil, which goes into the line and is connected with the receiver at the listening station. The vibrations are reproduced at the receiving end by the current passing around the electro-magnet which is on the end of a permanent magnet, or in the Baxter case; I believe it has no soft iron coil in the Baxter receiver. It has a permanent magnet, around one end of which is a coil which causes variations in the magnetism in reproducing the vibrations of that end, communicated from that to the air and reproducing the sound waves which is conveyed by the air.

Int. 75. How does the instrument compare in its operation with the Reis cubical box form and the Reis-Legat form?

Ans. The operation is identical in both cases. If you were to make too loud a sound, why you would break the contact and interfere with speech. In fact, you would have to speak louder on the Legat transmitter to break the contract than you would on the Baxter, and there is no sticking between the electrodes. Take the same distance with which you are talking on the Baxter from the Legat and you will find that you will have to yell to get any sounds through it. This idea that it is necessary to whisper in the Reis instrument is not so; as I find that I have to speak in quite a loud voice to get any results.

Int. 76. Have you examined the Baxter instrument sufficiently to know whether it is capable of being used entirely without the coil at the end of the bar?

Ans. Oh; yes, sir; you mean the coil of the receiver?

Int. 77. I mean the coil which you refer to acting as a spring?

Ans. Oh, yes; it can be used without that.

Int. 78. Without that coil how does it differ in principle and mode of operation from the Reis cubical box transmitter?

Ans. There is no difference, with the exception that it is tipped up.

Int. 79. Suppose you take a Baxter instrument and turn it down, in the same way as the Reis?

Ans. It will work then.

Int. 80. Will it then differ at all from the original Reis instrument.

Ans. The only difference is in the iron diaphragm and the carbon disk. The operation would be identical.

Int. 81. If the Reis instrument actually does transmit speech, and actually does make and break the circuit while doing so, to some minute degree, is that necessarily the case also with the Baxter instrument when producing the same effect.

Ans. Yes, sir.

Int. 82. If the Reis instrument does not work by an undulatory current upon the principle of Mr. Bell's patent, does the Baxter instrument work upon that current or principle?

Ans. The Baxter instrument works on the same principle that Reis' did when it transmitted speech.

Int. 83. Does it work upon the principle or in the method pointed out by Bell as to figure 7?

Ans. It does not.

Int. 84. In what respect is the operation different?

Ans. Bell's is a magnetic telephone. In other words, a small dynamo machine.

Int. 85. Why do you call it a dynamo?

Ans. Because it is an instrument which produces currents by varying the points of the magnetic poles, or by causing an armature to approach or recede from the poles of the permanent electro-magnet. The results are the same.

Int. 86. How would you describe the operation of the Reis and Baxter instruments?

Ans. The Reis is a battery transmitter and requires a battery to operate, by disturbing the current—the voltaic current. The disturbances in the voltaic current cause also disturbances or variations in the magnets which have a greater or less attractive force in the armatures.

Int. 87. Do you consider the Baxter instruments an infringement on the Bell patent of 1876?

Ans. I do not.

Int. 88. Do you consider that mode of transmission now in almost universal use to be the system of the Bell patent?

Ans. I do not.

Int. 89. Of what do you consider that whole system the natural development—the system of microphonic transmission?

Ans. What do I consider it is?

Int. 90. From what instruments or descriptions has it been developed?

Ans. The microphone transmitters are all modifications of the Reis instruments, and without those modifications to-day the Bell telephone so-called would be nothing more than a toy, as you can transmit but a very short distance, and then only under favorable circumstances with two Bell telephones. The battery transmitter is what has given it its commercial value. Taking that away from it it would be, as I have before stated, almost a plaything. In conformation with the Reis instrument, as it is well known, you can transmit sounds and speech as far as the electric current will permit you to; that is, say a hundred miles on the direct current.

Counsel for complainant gives notice, as he has heretofore given notice, to the counsel for the defendants, to have the various instruments which the witness testifies to as talking telephones produced and the experiments repeated in the presence of the witnesses of the complainant, as was done in the Dolbear case.

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Eliphalet W. Smith, a witness sworn on behalf of the defendants, testifies as follows:

Examined by Mr. Keasbey:

Int. 1. Where do you reside?

Ans. Newark, New Jersey.

Int. 2. What is your business?

Ans. I am in the employ of the Overland Telephone Company of New Jersey.

Int. 3. How long have you been employed practically in relation to the telephone?

Ans. About five years.

Int. 4. For whom were you originally employed?

Ans. The Domestic Telephone and Telegraph Company of Newark, operating under the Bell patent in the city of Newark.

Int. 5. How long did you continue in their employ?

Ans. I think about four years—nearly four years.

Int. 6. Are you practically familiar with the use and operation of the telephone?

Ans. I am.

Int. 7. Have you seen the publications of Reis and the drawings of the cubical box transmitter and the knitting needle receiver as shown on page 346 of the Book of Inventions?

Ans. I have seen it in this book.

Int. 8. Did you see it also in the book of Prof. Sylvanus P. Thompson, on page 86?

Ans. Yes, sir.

Int. 9. How does the drawing on page 86 of that book compare with the drawing in the Book of Inventions published in 1865?

Ans. I should say that it is the same, with the exception that the battery is shown here, which is not shown there. The battery is not shown on the little book, but only represented by "B."

Int. 10. Did you make an instrument after that drawing for experiment?

Ans. After the drawing on page 86 of Thompson's book? I did.

Int. 11. Had you any other instructions for making the instrument in that drawing than the description of Reis relating to it?

Ans. No other instruction; no, sir.

Int. 12. Did you make it precisely in accordance with that drawing?

Ans. As near as I could, with the exception that the mouth-piece was composed of paper instead of tin.

Int. 13. Were the working parts the same?

Ans. The working parts were the same. This little hammer at the top, I think, was made of iron wire instead of spike wire. I used a number of different hammers and a tin diaphragm on it.

Int. 14. For the purpose of experiments?

Ans. Yes, sir.

Int. 15. Were you able to transmit speech with that instrument—with the transmitter and receiver together?

Ans. To a very limited extent.

Int. 16. To what extent?

Ans. I could hear the sound of the voice; could know that the person was speaking and could tell that they were words, and at times I distinguished words, but it was very rarely that I could distinguish words when the receiver and transmitter were working together.

Int. 17. Did you make experiments with the transmitter and another receiver?

Ans. I did.

Int. 18. With what result?

Ans. Much better result. With the Baxter receiver I found that the transmitter would transmit words and sentences at times so that they could be understood quite well.

Int. 19. Have you the instrument in your possession now that you made?

Ans. I think I have parts of it yet. I have the princip parts at any rate. Whether I have everything at this time or not, I couldn't say.

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Int. 20. How does the Baxter instrument compare in its mode of operation with the Reis transmitter, and in its construction?

Ans. They both work by a loose contact, and in that receiver, I think they are about the same. I can't see any material difference; but of course, there are improvements in the Baxter transmitter, such as the carbon button, induction coil, etc., that are not in the Reis instruments.

Int. 21. With the exception of the carbon button and the use of the induction coil and the use of the magnet at the end of the bar, is there any difference in its mode of operation or construction?

Ans. The movable arm in this transmitter is a straight arm while in that it is an angular piece, and I think if this was an angular shape piece and was joined at each termination of these angles, it would be pretty much the same thing.

Int. 22. There is a difference in the material of the diaphragm?

Ans. Yes, sir; this is composed of iron, and that was a membrane.

Int. 23. Your Baxter instruments operate without the coil and magnet at the end of the bar?

Ans. I think it will; I never tried it.

Int. 24. If these instruments instead of being used in an upright position were constructed to be used as the Reis cubical box transmitter, and without the coil and magnet at the end of the bar, how would it then compare in mode of operation with the cubical box transmitter of Reis?

Ans. I should think that the action would be very much the same; if there was a drop of mercury put in between one of those joints, I should say it was. In the Reis instrument it is at the end of the drop, and here we have a pin running through the arm, and it is hung on two little screws, and with a pin secured between the mercury plates; I should think then it would act.

Int. 25. What was the object of that drop of mercury in the Reis instrument?

Ans. It was to insure the current not being broken at the electrodes.

Int. 26. You speak of the current being broken at the electrodes; is it your opinion that the current in the Baxter transmitter is broken at the electrodes?

Ans. Well, I can't say in regard to that.

Int. 27. Why can't you tell?

Ans. Because I don't think I am competent to; I think at times it is broken.

Int. 28. Can you tell whether or not it is broken in the ordinary transmission of speech?

Ans. I can't tell.

Int. 29. If it is broken at the electrodes in the Reis cubical box transmitter, must it also be broken in this transmitter?

Ans. Yes, sir; I think it must.

Int. 30. So far as making and breaking the current is concerned, is there any difference between the operation of the two transmitters?

Ans. I don't think there is any difference.

Cross-examined by Mr. Dickerson:

X-Int. 1. What is your official position in the Overland Telephone Company?

Ans. Superintendent.

X-Int. 2. Have you examined the letters patent of Baxter under which these instruments are made and licensed?

Ans. I have read the specification and patent.

X-Int. 3. Do you think Baxter knows as much about his invention as you do?

Ans. I really can't say in regard to that; I should suppose he ought to know a good deal more.

X-Int. 4. Do you claim to know more about his invention than he does?

Ans. No, sir.

X-Int. 5. Is it your opinion that the Baxter machine operates by making and breaking the current; or by main-

taining a constant current and causing it to undulate in using with the air waves?

Ans. Well, I think I have said before that I did not profess to know, and I wouldn't like to say.

X-Int. 6. In Baxter patent No. 277,198, this statement is made: "The object of my invention is to provide means whereby the limit of variation in the strength of a voltaic current may be greater than at present. This refers to the undulatory current used for generating a current for the transmission of speech telephonically, and which, as is well known, is the result of a variation gradual in its nature from strong to weak and *vice versa*. When the current sent to line is due to magnetic induction from a permanent magnet, the variation to which it owes its existence is effected by strengthening or weakening said magnet; but when said current is derived from a galvanic battery by induction, the variation is produced in the primary or direct battery current."

Do you consider that a true or false statement of the operation of this machine?

Ans. I think that is true.

X-Int. 7. And Baxter also says: "The operation of my invention is as follows: Supposing a given current from the battery to be flowing, the attractive force exerted upon D by E will cause a firm contact between p and d, which will be approximately the mean of pressure or of surface contact. If now a heavy impulse thrusts forward the stud *p* against *d* the result will be quite different from that observed when the suspended bar B is held in place merely by gravity or by a spring. Instead of being carried away by its momentum, thus breaking the circuit, the bar C is held in closer contact by the increased attractive force of core E, such increased attractive force being due to a stronger current operating upon it, and such stronger current is obtained by the increased contact between *p* and *d* by the thrust of *p* against *d*. For this reason more ample vibration can be given to the diaphragm without 'breaking.'"

Don't you understand that to be a statement by the

patentee that his machine operates, or is designed to operate, without breaking, and that his invention says it prevents breaking?

Ans. I should say it did.

X-Int. 8. And don't you suppose that is a true statement?

Ans. I have no reason to think otherwise.

X-Int. 9. And isn't it also true that the bar supporting the carbon button is made heavy in order to give it an increased inertia, so that it will not fly away from the opposite electrode when the diaphragm is spoken to?

Ans. Yes, sir; so that it does not fly away too far.

X-Int. 10. Isn't it so that it will not fly away and break the electric circuit or current?

Ans. I couldn't say.

X-Int. 11. Then you don't know what that increased inertia is applied for?

Ans. I can't say whether the current is broken at the electrodes or not. It may be at times; at other times it may not be.

X-Int. 12. I have not asked you whether it is broken or not; I asked you whether that increased inertia is applied there for the purpose of preventing it from being broken?

Ans. It is applied there for the purpose of preventing the electrodes from separating too widely.

X-Int. 13. What do you mean by separating too widely?

Ans. Making the separation too great.

X-Int. 14. What is the effect of separating too widely or making it too great?

Ans. If the separation is too great, I think the articulation is impaired.

X-Int. 15. Don't you know, as well as you know anything about the subject, that when the separation is too great the electric current is broken and the current ceases to flow?

Ans. Yes, sir.

X-Int. 16. In consequence of which articulation is destroyed?

Ans. If the separation is destroyed.

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X-Int. 17. If the separation is sufficient to break the flow of the current, does not that circumstance cause a jar or concussion to be heard in the receiver?

Ans. Yes, sir.

X-Int. 18. And to that extent destroys articulation, does it not?

Ans. I would not say that it destroyed it, but it impairs it.

X-Int. 19. And if it is repeated frequently it destroys, does it not?

Ans. I should suppose it would.

X-Int. 20. If it is repeated once at each air vibration, it would certainly destroy speech, wouldn't it?

Ans. I couldn't answer that.

X-Int. 21. Have you no opinion on that subject?

Ans. I don't think I have.

X-Int. 22. In the description of the Reis-Legat machine it is said: "It is also observed that the lever itself being made as light as possible that it may follow the movements of the membrane * * *. When at rest the electric circuit is closed. When the air which is in the tube *a b* of the apparatus, Fig. 4 A, is alternately condensed and rarefied by speaking into it (or by singing or introducing the tones of an instrument), a movement of the membrane closing the smaller opening of the tube, is produced responsive to such condensation or rarefaction. The lever *c d* follows the movements of the membrane and opens and closes the electric circuit at *d g*, so that at each condensation of the air in the tube the circuit is opened, and at each rarefaction the circuit is closed.

"In consequence of this operation an alternate demagnetization and magnetization of the electro-magnet of the apparatus, Fig. 4 B, is produced, resulting from the condensation and rarefactions of the air in the tube *a b* of the apparatus, Fig. 4 A, and thus vibrations corresponding to the vibrations of the membrane in the transmitting apparatus are induced in the armature of the magnet."

Now, do you mean to tell me that in your opinion the

Baxter instruments that are working under your superintendence operate in that way, by opening and closing the electric circuit at each vibration?

Ans. I don't think I am competent to say whether the circuit is made or broken at the electrodes. I think it is a question that is yet to be decided.

X-Int. 23. When you made your Reis instrument and got some kind of words through it, did it make and break the circuit, or did the electrodes continue in contact at the time when you got the word through it?

Ans. That I couldn't say.

X-Int. 24. In your experience is it not true that whenever the current is broken in these Baxter machines by too loud speech, or otherwise, there is a violent concussion in the receiver?

Ans. If the electrodes separate too widely then the sound is impaired.

X-Int. 25. If they separate enough to break the electric current, isn't there a violent concussion in the receiver?

Ans. I can't tell whether the electric current breaks or not at that point; I don't know.

X-Int. 26. Is not the impairment then, if you prefer that word of speech, due to the fact that the whole battery strength is suddenly taken off and suddenly let on by the making and breaking of the current, and that the diaphragm responds to that sudden increase of magnetism by a concussion which impairs speech?

Ans. I should say partly to that and partly to the rattling of the arm against the diaphragm when it separates too far.

X-Int. 27. Is the rattling of the arm heard at the distant station?

Ans. Yes, sir.

X-Int. 28. You don't mean by that to say that the air vibrations produced by that rattling are produced at the distant station?

Ans. I know that if you rattle the arm on the diaphragm you can hear it at the distant station.

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X-Int. 29. Isn't it due to the fact that the rattling of the arm makes and breaks the current so that at the distant station the magnet is magnetized and demagnetized, which makes and breaks the current?

Ans. I think not there. If I strike the diaphragm with a pencil or any hard substance, it can be heard at the distant station; and, consequently, if the arm strikes against the diaphragm, it easily can be heard at the distant station.

X-Int. 30. Then you think that the air vibrations occasioned by the rattling, act upon the diaphragm and cause the variation in the undulations of the current, and that those vibrations are what produces the sound at the distant station; is that what you mean, just as striking any other hard substance in the vicinity of the transmitter would produce that effect?

Ans. That is partly the case, I think. Of course, if the current is broken I should suppose that could be heard at the distant station.

X-Int. 31. Is it your opinion that the making and breaking of the current produces a much more violent effect upon the distant receiver than any rattling noise in the vicinity of the transmitter produces when the current is not broken by it?

Ans. I know that when you make and break the circuit that it does produce a loud sound at the distant station, but whether the sound would be louder than any sound that might be made in the vicinity of the transmitter, I couldn't say with regard to that.

X-Int. 32. Isn't that loud sound due to the fact that the magnet at the receiving end is demagnetized and remagnetized by the interruption of the current?

Ans. I think it is.

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Charles A. Young, a witness produced on the part of the defendants, having been first duly sworn, testified as follows:

Examined by Mr. Keasbey:

Int. 1. You have already been examined in the case of the American Bell Telephone Company against the People's Telegraph and Telephone Company?

Ans. I have.

Int. 2. That testimony has been stipulated into this case and makes unnecessary any preliminary examination as to your position. Are you still engaged in investigations concerning the telephone and kindred matters?

Ans. I am.

Int. 3. Have you examined the instrument known as the Baxter instrument, made under the Baxter patents and used by the defendants in this cause?

Ans. I have.

Int. 4. Will you explain the nature and mode of operation of that instrument, and compare it with the instrument described in the Reis publications?

Ans. The transmitter of the Baxter instrument consists essentially of a diaphragm which is usually made of metal. On the back of it is suspended on pivots an iron arm carrying opposite to the center of the diaphragm a bolt with a button of carbon or some carbonaceous material. This is nominally in electric contact with a small knob of platinum attached to the center of a diaphragm. This iron bar hangs vertically. Opposite to the lower end of it is a soft iron rod threaded with a screw thread, so that by turning it its distance from the iron bar can be adjusted. This iron rod is surrounded by a coil of wire which is nominally in the battery circuit, so that when the instrument is in operation the carbon button would be lightly pressed against the platinum knob in the magnetic action of this iron material. The connections are so made that the current of the battery, after passing through the diaphragm, the carbon button and hte magnet coil surrounding this "controlling magnet," as

Mr. Baxter calls it in his patent, passes through the primary of a small induction coil such as is ordinarily used in other telephonic systems. The secondary or fine wire coil of this induction coil is connected with a line which passes to the distant receiver. The receiver consists of a "U" shaped magnet of fine steel about a quarter of an inch in diameter, upon one pole of which is wound, first, a coil of fine copper wire, then, in the instrument before me, a coil of iron or steel, and finally around this another coil of fine copper wire, the whole forming one continuous coil, which is connected with the line wire. A diaphragm of thin iron is placed in such a manner that one edge rests upon one pole of the magnet, while the center of the diaphragm is opposite and near to that pole of the magnet which is surrounded by the coil.

I understand the operation of the instrument to be as follows: When articulate speech is uttered in front of the transmitter diaphragm, the diaphragm is put in vibration at the point of loose contact between the platinum button on the center of this diaphragm and the carbon button on the suspended iron rod, slight motions result which lead to changes in the intensity of the primary circuit. These changes in the intensity of the primary current produce electric pulses or waves in the secondary coil of the induction coil, which are communicated through the line to the coils of the receiving instrument, and produce in the diaphragm of the receiving instrument oscillations sufficiently similar to the vibrations of the transmitter diaphragm to permit the recognition of words spoken at the transmitter.

The operation at the transmitter diaphragm is precisely of the same character as that at the loose contact of the various forms of the Reis apparatus, the only difference, in my opinion, being that a piece of carbon is substituted for one of the pieces of metal which Reis was accustomed to use.

Int. 5. Was carbon now used in these instruments and in general electrical contrivances, known at the time of the Reis publications?

Ans. It was known, and to a small extent used in laboratory experiments upon the electric lights, but was not commonly employed nor easily obtainable by a person in Mr. Reis's position.

Int. 6. Will you state wherein this instrument, the Baxter transmitter and receiver, are different either in construction or mode of operation from the instruments and process described by Bell in the fifth claim of his patent of 1876, and whether the instrument and process described in that patent are embodied in the defendants' instrument?

Ans. In the Baxter instrument there is no resemblance whatever to the transmitter described in the patent of Mr. Bell referred to; the only transmitter described in that patent is a so-called magneto transmitter in which the pulses there effected in the transmission of speech are produced by the oscillation of an iron armature in front of the poles of the electro-magnet.

The method of operation of this transmitter is not entirely different because the oscillations or changes of the intensity produced in the primary current result not from the introduction of the electro motive power caused by the vibrations of the diaphragm, but result from changes in the intimacy of contact at a loose joint.

The receiving instrument undoubtedly embodies the same principle as the instrument described for the reception of musical sounds in that patent, musical or vocal sounds in that patent; but in a very much improved form, having in place of a membrane with diaphragm attached, a metallic diaphragm, and having special improvements in the coil surrounding the magnet pole, which make the instruments more effective. It also uses a permanent magnet instead of the electro-magnet described in that patent.

Int. 7. In the Bell apparatus described in the patent No. 174,465, has the voltaic current any other function than that of magnetizing the electro-magnet?

Ans. I think not; because it was very soon discovered that it might be dispensed with by using permanent magnets in place of the electro-magnet.

Int. 8. Do you consider the defendants' transmitter to be an infringement of the transmitting instrument in the Bell patent?

Objected to by Mr. Dickerson, counsel for complainant, as improper question and as being a question of law.

Question withdrawn.

Int. 9. Do you consider the undulatory currents described by Bell in his patent of 1876, necessary for the transmission of speech?

Ans. I do not. I know that it is possible to produce on the electric circuit by suitable mechanism, a series of makes and breaks so that an ordinary receiving telephone in the circuit will utter articulate words to the ear of an auditor; and if this is possible, I see no reason why, if a telephone transmitter, in the ordinary sense of the word, should be constructed in such a manner that it would produce in the electric circuit a similar series of makes and breaks, the telephone receiver at the other end would not reproduce the words spoken at the transmitter.

Int. 10. Have you made or been present at experiments made for the purpose of demonstrating the fact that words can be transmitted to the receiver by means of such mechanism, where the current is manifestly made and broken?

Ans. I have been present at such experiments made by others, have assisted in them, and have heard words thus produced. I am at present engaged in connection with my colleague, Professor Brackett, in a series of experiments directed to the same object, but planned in a different way.

Int. 11. Can you state about what length of time will be required for the completion of those experiments in which you are now engaged?

Ans. It is never possible to state with certainty how long a new experiment will take in its completion, but I should think as things now appear, I would probably be able to complete them and reach a satisfactory result within a month. I will add, we are not able to prosecute the experiments as rapidly as we would like, because of our engage-

ments with the college and other duties which prevent us from devoting other than a small portion of our time to that purpose.

Int. 12. You have stated that the defendants' transmitter operates in substantially the same manner as the Reis transmitter, and belongs to the same class. Can you at present state whether the statement made by Reis, that the current was made and broken by the movements of the diaphragm in accordance with the vibrations of the air during the transmission of speech, is a correct statement of the actual mode of operation?

Ans. I meant by placing the defendants' transmitter in the same class with the Reis instrument, that its action depended entirely upon the effect of the loose contact, or as the defendant in his patent describes, "an unstable contact" between conductors. It is at present a question in debate among authorities whether, when the Reis instrument is successfully used for the transmission of speech, that the action is really an entire breaking of the circuit or not, and in the present state of the art, I do not think it possible to pronounce Reis's description of the action to be either absolutely correct or incorrect.

I might say, that at the time he wrote, the question of a possible distinction between making and breaking by a loose contact, or any variation of the resistance without absolute breaking, had never been raised; and probably he did not consider the question important for his purpose.

Int. 13. If speech is actually transmitted by the Reis instruments as described in his publications, are the operation and method, whether the current be actually broken in some minute degree, the same in the defendants' transmitter, and in the transmitters in modern use?

Ans. The action of the Reis transmitter, when it transmits speech, is in my opinion unquestionably the same as that of any other modern transmitter. There is no ground for any distinction between their operation except that the modern transmitters by the use of carbon, are able to do the thing more easily and certainly, and by easily, I mean they

require less care in their adjustment, and the adjustment once obtained remains perfect for a much longer period.

In my opinion, the modern transmitter is a mere improvement on the Reis transmitter. The question as to the precise nature of the operation at this loose contact is, as I have said before, a matter still under debate and it is questionable whether or not Reis's description of the operation of his instrument is to be regarded as correct or inaccurate, though undoubtedly a very considerable number of scientific men at the present day consider it inaccurate.

Int. 14. In the patent of Baxter, No. 277,198, he says: "The object of my invention is to provide means whereby the limit of variation in the strength of a voltaic current may be greater than at present. This refers to the undulatory current used for generating a current for the transmission of speech telephonically, and which, as is well known, is the result of a variation gradual in its nature from strong to weak and *vice versa*." In your opinion, what did he mean by this statement?

Ans. I think that he simply adopted the view which has been promulgated by Mr. Bell and by certain scientific experts who had testified in support of the Bell patents in certain cases that came to a hearing before, and that his statement is not to be taken as conclusive with respect to the real action of his transmitter, which obviously, of whatever nature this action may be, is the same as that of the Reis and all other microphonic transmitters.

Int. 15. You are now shown the book of inventions published at Liepsic and Berlin in German in 1865, and referred to page 347.

Have you ever seen that publication before?

Ans. I do not know that I have; I do not think I have.

Int. 16. Can you read German?

Ans. I can.

Int. 17. Have you read the article entitled "Telephony," on that page and the following?

Ans. I have.

Int. 18. Do the drawings on page 348 compare with the

drawings of the Reis cubical box transmitter and the knitting needle receiver with those you have seen in other publications and in the course of this case?

Ans. They are practically identical, though I think made from different blocks. I think the cut is made from a different block from any other that I have seen before.

Further taking of testimony was then adjourned to Saturday, December 17th, 1885, at the same place.

C. N. WILLIAMS,
Special Examiner.

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721 BROAD STREET, NEWARK, N. J.,
January 17, 1885—11 a. m.

Testimony resumed.

Professor Charles A. Young presents himself for cross-examination.

Cross-examined by Mr. Dickerson:

X-Int. 1. Isn't it true that there is a clear distinction between two telephones for the purpose of transmitting sounds which are generated in the air at the transmitter, in one of which the electric current is broken at each complete air vibration, and in the other one of which the electric current is never broken during the transmission, but is maintained in constant continuity?

Ans. Ordinarily there is such a distinction. A distinction may also be drawn between a telephone in which there is no break of the continuity of the current during the transmission and another class of telephones in which such breaks may and do occur more or less frequently.

X-Int. 2. I request you now to answer the questions that I put, and not go on to the discussion of something not asked about. I now ask you this question: Isn't it also true that in a telephone in which the continuity of the current is preserved, articulate speech may be transmitted, and that in a telephone in which the current is broken at each

complete air vibration, articulate speech is necessarily destroyed?

Ans. It is true that in telephones in which the circuit is maintained unbroken, articulate speech may be transmitted. I do not know of any evidence that in a telephone in which the circuit is broken more or less completely at every air vibration, speech cannot be transmitted.

X-Int. 3. Do you believe it to be true, and if so, state the fact within your knowledge which justifies that belief, that a telephone in which, when the sound is made by the speaker at the transmitter, the current is actually broken at each complete vibration, speech can be transmitted by that instrument?

Ans. I may guard my answer a little carefully. I do not know any telephone in which it is certain that the current circuit is completely broken at the transmitter at each vibration of the air, but my reason for believing that if such a telephone transmitter existed speech might be transmitted by it, rests upon the fact which I have myself observed, that articulate sounds can be reproduced in the telephone receiver by a series of separate makes and breaks produced in a circuit by means of a suitable apparatus, as detailed in the experiment referred to in my examination.

X-Int. 4. Do you believe it to be true that any telephone exists in which, if, when the speaker speaks to the transmitter, the circuit is absolutely broken at each complete air vibration, speech can be transmitted by that instrument?

Ans. I do not know enough about the electrical action of loose contact pieces to assert that in any telephone transmitter now existing the circuit is or is not broken at each vibration of the air, during the transmission of articulate speech.

X-Int. 5. I assume the existence of a transmitter such as Reis's, and I assume for the purpose of the question, that the contact is actually broken and the electrical current actually interrupted at each vibration, as described by Reis. Now, with that assumption, do you know enough about the laws that govern the transmission of articulate speech to

say whether articulate speech could be practically transmitted under those circumstances?

Ans. I certainly am not prepared to say that it could not.

X-Int. 6. Do you believe that it could, or do you wish the Court to understand that you believe that it could?

Ans. I wish the Court to understand that in my opinion, that is a question not yet thoroughly settled.

X-Int. 7. Have you no opinion about it. I am not asking whether it is settled in other people's mind, and if you have an opinion about it, I ask you to give it.

Ans. My opinion is simply this: that it is not yet settled, and I am not satisfied that speech may not be transmitted even when there is a complete interruption of the current at each vibration, and by means of that interruption of the current; but, of course I know, as every one knows, that if, at the time of the interruption, the loose contact piece jumps to any considerable height above the membrane, then the transmission of speech is interfered with.

X-Int. 8. Supposing the interruption of the current at each air vibration to be exactly such as described in Reis's publications, so that at each air vibration the battery current is let off and let on to the receiver; don't you know as well as you know anything about the subject, that would be entirely destructive of the transmission of articulate speech, if one were speaking to the transmitter at that time?

Ans. The limitation of the question by the introduction of the words "as described by Reis," and imposing upon the words that sense in which the words would be now used in distinguishing between makes and breaks of the current, and the increase and diminution of its strength, causes a little difficulty in answering it definitely. It is my belief that the variation in the strength of the current during the air vibration may go from the full current strength to absolute zero without interfering with the transmission of speech.

X-Int. 9. I have no doubt of that because it does that in Bell's magneto telephone, and therefore, I will try again. I now ask you whether, if it be true, no matter what in-

terpretation is put upon Reis's language, that the current is actually broken at each rarefaction and condensation of the air produced by speaking to the transmitter, articulate speech can be practically transmitted under those circumstances, in your belief?

Ans. If in the use of the transmitter of the Reis type, in the direct circuit, that is without an induction coil, the strength of the current ever does fall to zero, it must imply a complete break of the circuit, and it is my belief that while, perhaps, this falling of the current to zero may not actually occur at every rarefaction and condensation, the breaks producing such a fall to zero may recur very frequently during the actual transmission of speech, and may be finished in that transmitter.

Int. 10. I have not asked you to explain any theories about the connection between the breaking of a circuit and the zero of the current. The question I ask is, supposing the current to be absolutely broken at each air vibration produced by speaking to the transmitter of Reis, so that there is no current on the receiver during that rupture, isn't it perfectly certain to your mind that such a state of things is entirely destructive of the transmission practically of articulate speech?

Ans. Since the intensity of the vibrations in articulate speech varies very greatly, it would, of course, not answer, that there should be a complete rupture of the circuit at all of the vibrations, but only ruptures corresponding to the more intense vibrations; otherwise, there would be no shading, if I may use the expression, in the intensity of the pulses received at the receiver; but I believe that if those breaks should be by the action of the transmitter properly spaced as to length and time thereof upon a line of any considerable length, the self-induction of that line would produce the requisite shading, and the articulation would be more intelligible.

X-Int. 11. Do you mean by all this to say that Reis's transmitter is an apparatus in which spacing is provided for in the transmitter, so that the circuit may be broken

absolutely under proper spaces when that instrument is used?

Ans. Certainly; especially if it is modified by putting a bit of carbon at the contact point, under which circumstances it talks as well as any transmitter.

X-Int. 12. Does it talk as well as transmitters in which the current is not broken, if there is an actual rupture at each vibration in the current?

Ans. What I mean to say is simply that the Reis transmitter talks nearly as well as any form of loose contact transmitter when carbon is used instead of platinum. I do not, of course, mean to say that platinum is as good a material as carbon, and I do not know in loose contact transmitters just how often the breaking of the circuit occurs, or to what extent it goes. I have testified already that there is a question not settled in my mind, nor, so far as I know, in the judgment of electricians, as to the precise manner in which the strength of the current is increased and decreased, or made and broken at the loose contact joint in the carbon transmitter.

X-Int. 13. Don't you know it to be true that when the current in the microphone transmitter is actually broken and re-closed, it is followed by a violent concussion in the receiver which the ear perceives instantly?

Ans. Usually this is the case, but I do not think it is always, provided the making and breaking is managed with sufficient gradualness.

X-Int. 14. Have you yet been able to manage your voice with sufficient gradualness to break the electric current in a microphone transmitter and reform it in the act of speaking, so that the receiver did not experience a concussion which was disagreeable to the ear, and if so, just describe how you managed your voice, in order that the experiment may be tried and verified?

Ans. My statement related not to the making and breaking of the microphonic circuit by the voice, but by an apparatus by which the alteration could be very gradually performed. It is unquestionably very difficult to break

the circuit completely by any such means without giving a shock to the receiver, but it can be done.

X-Int. 15. Now, as you know, I was not asking you about machines by which the current could be so gradually diminished and increased as not to shock the receiver. I was asking you about the transmitter to which the human voice was speaking, and I repeat the question with that explanation. Have you ever been able to so manage your voice, or have you seen anybody else who was able to so manage his voice, as that the electric current was actually broken and remade by the act of speech without transmitting a shock to the receiver? If you say that you have, explain how it is done, in order that the experiment may be repeated and verified?

Ans. If I were to answer captiously, I should say that in the judgment of numerous electricians ordinary speech at the microphone transmitter produces precisely this effect, but I think this is asserting more than we are entitled to assert in the present state of electrical knowledge. When the voice is raised loud enough to make the breaks palpable and evident and unquestionable, so that there is no possibility of discussion as to whether the circuit is made and broken, then with the ordinary microphone transmitter, as everybody knows, articulation is lost.

X-Int. 16. And is not articulation lost in consequence of the fact that the electric current is made and broken by the abnormal action of the transmitter?

Ans. I should say that the loss of articulation was not due to the making and breaking as such, but to the fact that when the irritation of the loose contact pieces become so violent, the makes and breaks no longer properly correspond to the vibrations of the diaphragm, and besides, the extra currents introduced by the self-induction of the apparatus come in to complicate the matter.

X-Int. 17. Then you mean to say, do you, that when the whole battery power is left off and the diaphragm recoils, and then the whole battery power is instantly let on again,

that act does not produce a violent concussion in the receiver, irrespective of any other condition whatever?

Ans. I don't think that I have said anything of the kind. It depends partly upon how long the battery power continues cut off. I should remark further, that the supposition that such a change can be instantly effected is impossible.

X-Int. 18. I agree that no cause and effect are instantaneous in a certain sense. I used the term as it is used in electrical science generally and commonly. I will try to be more careful hereafter and not excite hypercriticism. Do you know of any way, in which the current can be broken and remade in the speaking telephone transmitter either by the voice or by striking the diaphragm with a pencil, or any other way, in which there is not a shock transmitted to the receiver when the battery is in connection, whether you call it instantaneous, or have some more refined expression for the time occupied in performing the act?

Ans. I am not conscious of any hypercriticism in referring to the limitation "instantly," because the times occupied by the variations of the strength of the electric current under the circumstances of telephonic transmission are usually very sensible quantities as compared with the duration of sound vibrations and cannot be ignored. In an ordinary speaking telephone I do not know of any method by which the current can be made and broken, the makes and breaks being of such an extent that you would acknowledge them to be makes and breaks, without destroying articulation.

X-Int. 19. Do you know of any way in which it could be done, when the makes and breaks are such as that the current ceases to flow during the break?

Ans. I think that in ordinary telephonic transmission of speech, as I have said before, that at certain periods in the more intense vibrations the current may and often does actually cease to flow in microphonic transmitters just as it does in magneto transmitters.

X-Int. 20. Do you know of any way in which it can be

done if the battery current is withdrawn from the receiver and let on again so that the magnetism of the receiving magnet has ceased?

Ans. As I said before, I think that in the most intense of the vibrations of a transmitted word this very thing is required to occur, and often does occur, without interfering with articulation and, in fact, not only without interfering with articulation but giving it its maximum of intensity.

X-Int. 21. Then it is your opinion after all, that the current in the microphone transmitter is actually broken, so that the magnetism is discharged from the receiving magnet without producing any injurious effect upon speech? Isn't that the effect of your last answer?

Ans. Certainly: I think this is the case at certain points of the articulate word where the vibration is most intense, or at least it may be the case without damage to articulation. I do not think that in the case of this cessation of the current the magnetism of the receiver is entirely discharged, as that would require some time.

X-Int. 22. What do you mean by the expression, "a loose contact?" Give a definition for it. How much pressure makes it a close contact, and how little a loose contact?

Ans. A loose contact is a loose expression. I mean, a joint where two conductors touch each other, one of them being supported in such a way that a comparatively slight shock will cause their separation. I say, *comparatively slight*, because the question whether a contact is to be considered as loose or tight would depend upon the nature of the disturbances that are expected to act upon it.

X-Int. 23. Giving the case of a three quarter pound weight of carbon about two and a half inches square, resting on a corresponding block with joint horizontal, do you call that a loose contact when the problem is to speak to the upper block from the mouth vertically above it?

Ans. I suppose that would be so considered in electrical apparatus. At any rate, the jar produced by sound vibrations in the air causes a sensible disturbance of the electrical relation at the surface of contact.

X-Int. 24. And do you suppose that speaking to that block under those conditions causes it to be lifted away from the lower block to that extent that the electric current ceases to flow?

Ans. Probably not in this case, unless the voice is very loud.

X-Int. 25. And you think if you spoke loudly to it, it would lift itself so far away as that the electric current would cease to flow, do you?

Ans. It is possible to speak so loudly as to make the receiver squall or roar in the manner which you consider is produced by making and breaking in the Blake transmitter.

X-Int. 26. I read to you from the testimoney of your associate expert, Sylvanus P. Thompson: "I held, and still hold, that all that pressure can do at a so-called microphonic contact, is to increase or diminish the number of particles of the other surface, and that, therefore, it is strictly true to say that the effect of talking to a microphonic or loose contact, is to open or close the circuit more or less."

Is that the same that you mean when you talk about breaking the circuit in a microphonic contact, or is it something else?

Ans. I think the theory of microphonic action suggested by Mr. Thompson is a very probable one—perhaps the most probable of any—but I do not undertake to say that I am certain of its correctness as against that of some rival theories.

X-Int. 27. Then if that be the true explanation, the current is flowing constantly through the joint, but its strength is felt by diminishing or increasing the number of points of contact through which it flows, and thereby creating a resistance because of the diminished size of the conductor; isn't that so?

Ans. On that hypothesis, yes, sir; as I understand it.

X-Int. 28. Now describe the mechanical apparatus, in order that it may be made if desirable, whose action gives you the foundation on which you have been swearing, that possibly a speaking telephone can be made in which the current is actually broken?

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Ans. I preface my answer by saying that I have not asserted that a speaking telephone can be made which will operate by making and breaking the circuit, so that the makes and breaks would be admitted to be such by the counsel upon the opposite side. The apparatus which satisfies me that articulate speech may possibly be transmitted by makes and breaks produced by a transmitter, consists of a telephonic receiver of Mr. MacDonough's form in a telegraphic circuit, containing one cell Leclanc battery and a brass wheel about three feet in diameter, upon the circumference of which presses a spring, the whole being so arranged so that the circuit is complete through the wheel and the spring and the receiver with the interposition of resistance backs by which the resistance can be suitably felt. On the circumference of this wheel are cut a number of notches of varying depth and size, spaced and depthed according to the indications of a phonographic record. Upon turning with suitable velocity the word which has been cut upon the circumference of the wheel is distinctly heard in the receiver. The cuts upon the wheel are—many of them at least—of such a width and depth that there can be no possible question that the circuit is broken as the spring passes them, and that the articulation heard in the receiver is dependent upon the "pulsatory currents," to use Mr. Bell's expression, which are produced.

X-Int. 29. Is there more than one set of notches in the series, or are there more than one set which co-operate with the other in performing the usual result?

Ans. In this apparatus of Mr. MacDonough's, if I understand the question, only one series of notches is cut upon the wheel. Some of the notches are, of course, very shallow, some are deeper, and they are spaced according to the indications from the phonographic record from which they were made.

X-Int. 30. In the apparatus that you are working with, is there more than one set of notches employed?

Ans. We have not yet completed our apparatus far enough to get quite to this point. We propose to make

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provision by which we can use more than one set of notches for experimental purposes, if we think it necessary or desirable.

X-Int. 31. When you use more than one set of notches, the plan is to have the current flowing through one portion of the circuit while it is interrupted in the other?

Ans. By no means. Our plans, however, are not sufficiently formed to warrant any further statement than that we mean to try and find out what apparatus will answer best. Only we feel very confident from what we have seen so far that we shall be able to produce a word by means of breaks and makes of the electric circuit, as Mr. MacDonough has succeeded in already.

X-Int. 32. In the MacDonough apparatus, or in yours, considered as a telephone, when one desired to communicate to a friend he would first speak to a phonograph and obtain the indications on the tinfoil; he would then file up the notches in his wheel to correspond, and would then put it in circuit and turn the crank, and by that means send the message which he desired to communicate. Isn't that the mode of operation proposed in this new kind of telephone, provided it is put to practical use?

Ans. The apparatus of Mr. MacDonough, and the same is true of our own, was not proposed as an apparatus to be put to practical use in the transmission of speech, but as a scientific apparatus to settle the scientific question whether or not speech could be produced in a telephonic receiver by separate electrical impulses—that is, by makes and breaks—in the ordinary acceptation of the term.

X-Int. 33. And did you suppose it was of the least consequence in this case whether that were true or not?

Ans. It seems to me a very fundamental question in the case, whether, as claimed by the opposing counsel, speech can be transmitted only by the maintenance of a continuous current with variations in the makes and breaks; or whether it can be transmitted by separate electric impulses. That, however, is a question for the court to decide.

X-Int. 34. In respect to the Baxter receiver, don't you

find that the receiver in the Bell patent of 1876, Figure 7, has one end of the horse-shoe magnet connected to the armature, and the other end opposite to the armature just as it is in the Baxter receiver, so that the armature is itself magnetized?

Ans. Yes, sir.

X-Int. 35. And don't you find that the armature in the Baxter machine which, instead of being attached to the diaphragm, is itself the diaphragm by being made of iron, is the same thing as shown in Bell's second patent of 1877, in that respect?

Ans. In what respect?

X-Int. 36. In respect of armature and diaphragm together?

Ans. It has both armature and diaphragm together, and is magnetised by the action of the leg of the magnet with which it is in connection.

X-Int. 37. And do you mean to say that the interposing of a sheet of metal in the coil of the electro-magnet in the Baxter machine was either itself a new way to make an electro-magnet, or that it produced any new mode of operation in the telephone?

Ans. I think I said nothing as to its action beyond this, that the coil of thin iron wire or sheet iron, (for he describes both forms,) was intended to produce a more powerful magnetic action upon the diaphragm than would be produced by the ordinary central magnetic pulses alone; I have not experimented with the apparatus sufficiently to say how perfect the contrivance is.

I might add, I suppose it was his idea that it would enable him to produce a somewhat more powerful current than would be of any use in the ordinary telephone; as that seems to be his mode both in his transmitter and receiver.

X-Int. 38. Do you think that you know anything more about what Baxter means than what he wrote in his patent, and if so, where did you get your information?

Ans. I got it from reading the patent.

X-Int. 39. And by reading his patent, don't you think

that he meant to use the undulatory current for the transmission of speech telephonically, and which, "as is well known is the result of a variation gradual in its nature from strong to weak and *vice versa*?"

Ans. I do not think that he meant to draw any distinction between his transmitter and other microphonic telephone transmitters; and that in his description of the action, as I said before, he adopted the view which has been promulgated by Mr. Bell and other scientific persons.

X-Int. 40. You don't think that he was intending to invent, or that he thought he had invented, any new mode of operation, or machine by which he was to perform the result by means of circuit breaking as distinguished from a continuous current, do you?

Ans. I do not see any evidence in the language used in his patent that he himself considered his instrument to be free from infringement of Mr. Bell's patent on the ground that it was a circuit breaker, and did not employ continuous currents.

Re-direct examination by Mr. Keasbey:

Re-direct Int. 1. In your last answer do you refer to the actual mode of operation of the Baxter instrument, or only to the view of it expressed by the patentee in the language of the patent?

Ans. Only the latter.

Re-direct Int. 2. Do you intend to modify in any way your opinion already expressed, that the instrument does, in fact, work on the same principle as the ordinary microphonic transmitters in common use?

Ans. Certainly not.

Re-direct Int. 3. If the Blake transmitter and the ordinary microphone transmitters are in point of fact circuit breakers, is the Baxter transmitter also one?

Ans. Unquestionably.

Re-Cross by Mr. Dickerson:

Re-Cross Int. 1. Does not Baxter in his patent provide

means and patent them, for the purpose of preventing his machine operating as a circuit breaker under circumstances where other machines would be likely to break the circuit?

Ans. He patents an arrangement for increasing the pressure of the carbon button upon the platinum point roughly in proportion to the strength of the current which is used so that a wider than usual excussion of the platinum point can be produced by speech before the circuit is broken.

Adjourned to Saturday, January 24th., at the same hour and place.

CORRA N. WILLIAMS,
Notary Public.

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721 BROAD STREET, NEWARK, N. J.,
January 24, 1885—11 o'clock a. m.

Testimony continued.

Appearances: E. N. DICKERSON, Esq.,
for the complainant.
A. Q. KEASBEY, Esq.,
for the defendants.

Cyrus F. Brackett, a witness produced on behalf of defendants, being duly sworn, testifies as follows:

Examined by Mr. Keasbey:

Int. 1. Are you the witness already examined in the case of the American Bell Telephone Company against the Molecular Telephone Company of New York, which testimony has been stipulated in these cases?

Ans. I am.

Int. 2. Have you examined the instrument known as the Baxter instrument, made under the Baxter patents, and used by the defendants in these cases?

Ans. I have.

Int. 3. Will you explain the nature and mode of operation of that instrument, and compare it with the instrument described in the Reis publications?

Ans. I will. It is an instrument belonging to the general class of loose contact transmitters. It consists essentially of the following parts: Of an iron or other metallic diaphragm arranged in front of a mouth-piece so constructed as to make it easily accessible to sound waves, and carrying at its center a small metallic point. Directly above, and in general parallel with the diaphragm, is a hinged lever, which, in its central portion directly above the metallic point referred to, carries a carbon button adjustable with nuts and screws. The lever is either itself composed of magnetizable material or carries at its end such material so fastened and arranged that it is movable in front of the pole of the electro-magnet. This magnet is constituted such by being placed as a core in the center of a wire helix, which wire helix may be joined up in circuit of the primary battery. This primary helix may be surrounded, and in practice, I understand, is generally surrounded by a fine wire helix which constitutes a part of the telephone circuit. The mode of operation is as follows: The instrument being set up, it is so adjusted that when quiet, slight contact occurs between the carbon button and the metallic point attracted to the diaphragm, and these both form a part of the primary battery circuit, which circuit also, as above said, embraces the primary coil of the helix. When a sound is uttered, so as to displace the diaphragm, the metallic point is thereby caused to press with varying degrees of force in accordance with the intensity of the sound upon the carbon button. If the pressure be greater, more intimate contact is thereby produced, the resistance of the primary battery circuit is diminished, and the iron core constituting the electro-magnet has its magnetic moment increased; an increased attraction is exerted upon the end of the lever, by which the lever is caused to move toward the electro-magnet, and thus increase the pressure between the point and the carbon button. The object of this device is to prevent the button point from too readily parting company, or the distance between them might become too great, so as to interrupt the transmission of speech.

The description of the construction and operation of this instrument is, of course, confined to the transmitter.

The effective current on the telephonic line is produced by the induction set up between the two helices described.

Int. 4. Will you answer the latter part of the question, which refers to the Reis instruments?

Ans. I understand the action of the instrument to be essentially that of the Reis and other instruments employing loose contact, and it differs only in this respect, that instead of the circuit being entirely metallic, carbon has been introduced where the metallic point or lever in Reis's was by him employed, and that thereby an adjustment such as is required for the continuous transmission of speech is more easily secured.

Int. 5. Was the species of carbon now in general use in electrical contrivance known and easily obtainable at the date of Reis' publications?

Ans. In general, I should answer yes; but not known as a material suited to be employed as the contact pieces in telephonic apparatus. Gas coke was employed, which is essentially of the same character as now employed in the construction of the well-known Bunsen battery.

Int. 6. Will you state wherein the instrument known as the Baxter transmitter and receiver are different in construction or mode of operation from the instrument and the process described by Bell in the fifth claim of the patent of 1876; and whether the method and apparatus described in that patent are embodied in the defendants' instruments?

Ans. The transmitter described and shown in the Baxter patent is essentially and entirely different from that shown and described in the Bell patent alluded to. An apparatus such as is shown by Bell, if operated as a telephone, would do so by varying the current upon the line and producing momentary currents upon the line by magnetic induction. The one shown by Baxter and described by him will cause variations in the current by causing variations in the resistance at the loose contact embraced in a battery circuit. The one employs a battery; the other does not—or, at

least, need not, and in case it does, the use of the battery depends upon entirely different principles in the two instruments. The receiver described and shown by Baxter I regard as essentially the same in principle as the one shown by Reis. In proof of this view, it may be remarked that both contain magnets; both contain movable masses capable of magnetic induction, and both contain an expanding surface designed to set the air in vibration when their respective magnets vary their magnetic moment.

Supposing the Bell instrument to be employed as a telephonic apparatus it also would be in substantial accordance with the Reis apparatus—I mean when used as a receiver.

Int. 7. In the Bell apparatus described in Patent No. 174,465, has the voltaic current any other function than that of magnetizing the electro-magnet?

A. It has not.

Int. 8. Do you consider the undulatory current described by Bell in that patent necessary for the transmission of speech?

Ans. I do not.

Int. 9. Have you made or been present at experiments made for the purpose of demonstrating the fact that words can be transmitted with the receiver of a telephonic apparatus by means of such mechanism as would produce actual makes and breaks of the current?

A. I have.

Int. 10. Are you now engaged in connection with Professor Young in preparation for experiments directed to the same object?

Ans. We have such experiments under way.

Int. 11. Are you making those experiments at the request of counsel for the defendants in these cases, and for the purpose of having them put in evidence if they shall prove successful?

Ans. We are making them for that object.

Int. 12. If speech is actually transmitted by Reis's instrument as described in the publications of and concerning him—I mean, supposing it is—are the operation and meth-

od, whether the current be actually broken in some minute degree or not, the same in the defendants' transmitter and in the transmitters in modern use known as microphonic transmitters?

Ans. They are essentially the same.

Int. 13. Is there, in your opinion, any ground for distinction between the operation of the modern microphonic transmitters and the Reis instrument, except that the modern transmitter, by the use of carbon, is able to do the thing more easily and certainly and with readier adjustment?

Ans. There is no ground for any other distinction; it rests wholly in the use of carbon.

Int. 14. Do you regard the question as to the precise nature of the operation at the loose contact in the ordinary transmitter as one settled scientifically at this time?

Ans. I do not. There is considerable doubt and a good deal of discussion as to the precise operation.

Int. 15. Are your experiments now going on directed to the solution of the question which you thus consider in doubt?

Ans. They are in part; that question is involved.

Int. 16. You are now shown the book of inventions marked exhibit Volume 2, Das buch der Erfindungen, on the part of the defendants, and referred to page 347. Have you ever seen that publication before?

Ans. Beginning at the middle? Yes, I recognize it at once. I have never seen it in this form. I have seen the extract; I presume it is the same; but I have not seen this book before.

Int. 17. Will you look at the drawing on the following page of the Reis cubical box transmitter and the knitting needle receiver, and compare them with the drawings in the publications which have been heretofore offered in evidence and used in the course of these cases, and say whether they are identical or not, substantially?

Ans. They are substantially identical.

Int. 18. Does that drawing represent a transmitter and receiver substantially the same in construction as those with

which your experiments have been made, and concerning which you have given testimony in these cases?

Ans. It represents very accurately one form of the transmitters and receiver which are employed.

Cross-examined by Mr. Dickerson:

X-Int. 19. Do you mean to say that the apparatus described in the Reis publications and the mode of operation which is there also described, was substantially the same as the apparatus described in the Baxter patents, and the mode of operation there described?

Ans. In the essential features, yes. In the Baxter apparatus there is an addition which produced what he claims, and what may be called an automatic adjustment, by which it certainly seems evident that the current will be more fully under control. The operation of the transmitter is by loose contact, and hence by variation of the resistance as in the modern microphonic transmitter. The magneto receiver, in its general features, embodies the same principle as employed by Reis and by Bell.

X-Int. 20. As I understand the description of the Reis instrument, it describes a circuit breaker in which at each complete air vibration the circuit is actually broken. The Baxter specification uses this language: "The object of any invention is to provide means whereby the limit of the variation in the strength of the voltaic current may be greater than at present. This refers to the undulatory current used for generating a current for the transmission of speech telephonically, and this, as is well known, is the result of a variation gradual in its nature from strong to weak, and *vice versa*." Do you mean to say to the Court that those two descriptions are identical, or conveyed the same idea to a person versed in electricity?

Ans. I do not mean to affirm that the question which I was answering was a question put to me as to the explanation which I would give and which does not refer to the explanation given by Reis or by Baxter. Undoubtedly their language, taken literally, conveys more than either of

them know; certainly more than I would undertake to defend.

X-Int. 21. Then, if I understand your last answer, you are now telling the Court that Baxter's description isn't true, and that his transmitter is n't one in which the undulatory current is used and in which the contacts between the electrodes are intended to be maintained?

Ans. I only mean to say that the description appears to me in both cases to be given in the sense with the current language and current opinion, that for ordinary purposes it is sufficiently accurate, but that as I have replied to a direct interrogatory, the whole question of microphonic transmission is one still undecided as to its mode of operation.

X-Int. 22. Your associate expert, Sylvanus P. Thompson, has testified in these cases that microphonic transmission, as he understands it, results from the circumstance, that the opposite electrodes when subjected to varying pressure, rupture the current through a portion of the opposing surfaces, and leave it flowing through other portions so that the current is continuous. Your associate, Professor Young, last week,, when Thompson's explanation in his testimony was presented to him, said in substance, that he understood that to be the true explanation of the phenomena of microphonic transmission. Now, I ask you whether you agree or disagree with your two colleagues?

Ans. I have no doubt that the description of what occurs involved in the question is substantially correct, at least, I know of no evidence that it may not be so, when microphonic transmission is accomplished under certain circumstances in which the preasure and the violence of articulation are so adjusted as to secure such a result, as I have no doubt they may.

I have no doubt also that such continuity with any portion of the contact may be dispensed with without detriment, at least serious detriment, to the performance of the instrument.

X-Int. 23. And have you any doubt that in a transmitter for transmitting articulate speech which has been delivered

to it, and I ask you now not to confuse this question with a circuit breaking wheel made to imitate speech, when speech is transmitted through such a transmitter, an actual break of the electric current impairs, or tends to impair the perfection of transmission?

Ans. It undoubtedly may tend to do so, and if such breaks occur too numerously, and with too wide separation, no doubt may be fatal to it, and no doubt are fatal to it.

X-Int. 24. I shall ask you to change the tense of your verb, and to say whether you do not believe it to be true, that any such break under the circumstances of the question, does tend to impair articulate speech?

Ans. I have no objection to employing that form of expression in my answer.

X-Int. 25. You state in your direct examination that there was no difference between the Reis transmitter and the modern transmitter except in the circumstance that one employed carbon electrodes and the other platinum or metallic. When you made that statement, didn't you know that in all modern microphone transmitters for transmitting spoken words, the opposite electrode was supplied with a mass of metal much heavier than necessary for its support for the purpose of affording inertia to it, so that it would not readily part company with the electrode on the diaphragm?

Ans. I am not aware that such is the fact. It may be, and doubtless is, in some forms of instruments, but in others it certainly is not so.

X-Int. 26. Will you point out any telephone transmitter on the microphone plan, in which the opposite electrode is not supplied with inertia much greater than is necessary for the metal used for its support for the very purpose of preventing it from parting company with its opposite electrode; I refer you now to the Blake transmitter; to the transmitter in these cases, and to the Hopkins transmitter which you have, I think, seen, and to any other one that has been practically used in the art of which you have personal knowledge?

Ans. There are several forms of such instruments in my laboratory in which the construction is merely that of a small rod carbon pointed at the extremities, and lying in contact with two supporting blocks of carbon excavated to receive these points; no additional weight being used except that of the mere rod of carbon itself.

Certainly in one or two forms of European construction this same device is used. In the instruments of the Molecular Company in this country the same form is used if I remember rightly, substantially; the loose contact occuring between the blocks of carbon and the rods passing from them respectively, from one side to the other with no additional weight, with no spring or other adjustment.

X-Int. 27. In the Blake transmitter and in the defendants' transmitter in these cases, isn't it true that the electrode is provided with additional inertia for the purpose of preventing its parting company with its opposite electrode?

Ans. Such a statement is I believe nowhere made. There is a device in which perhaps the equivalent of the additional inertia is secured. I refer to the adjusting action of the electro-magnet in the primary helix.

X-Int. 28. I refer you in the defendants' machine to the heavy iron bar, which, in the specimen before you, hangs suspended from a hinge. Isn't that iron bar very much heavier than necessary for the support of the electrode, as in the Reis machine, and doesn't it afford inertia whose tendency is to prevent the rupture of the contact?

Ans. In the particular instrument shown me, certainly the iron bar has more mass than necessary for the mere support of the carbon button.

X-Int. 29. And in both those machines is there not also an additional artificial pressure applied to keep the electrodes in contact—in one a spring and in the other a magnetic pull?

Ans. Undoubtedly.

X-Int. 30. Do you find those appliances in the Reis instruments, the drawing of which you have exhibited here?

Ans. When the position of the two instruments is taken

into account, I do find in the Reis apparatus in the weight of the rectangular circuit breaker the precise equivalent. Also, in other forms of the Reis apparatus not here exhibited, the device of a spring is employed for the same purpose.

X-Int. 31. Then you mean to tell the Court, do you, that the rectangular bar of light material at the angle of which the electrode is situated, and the other extremities of which lie usually in a mercury bath, affords, in addition to the weight and inertia of the material, a spring or other artificial means to hold the electrodes in contact?

Ans. No, I do not mean to say this. I mean to say that the rectangular contact piece in this case lies horizontally, so that the full benefit of its weight at the contact piece is felt, while in the apparatus shown me, known as the Baxter apparatus, the position of the bar which carries the loose contact is vertical, and the component of force in this case is exceedingly small as compared with that which would be developed if it occupied a horizontal position, as in the case of the Reis instrument. In speaking of the spring adjustment of the Reis apparatus, I do not refer to the square box form, but to that apparatus usually known as the Reis-Legat, in which the spring is certainly shown and used.

X-Int. 32. Isn't it true, therefore, that in the defendants' transmitter, in addition to the inertia of the heavy bar which carries the electrode, and to the gravitating force which holds the electrodes in contact, there is another artificially contrived force to maintain the contact which is not in the Reis transmitter, of which you have produced a drawing?

Ans. It is undoubtedly true.

X-Int. 33. And isn't it also true that in that case, and in the case of the Blake transmitter, if that artificial additional force were removed, and the weight of the bar carrying the electrode were reduced to the same quantity that it is in the Reis instrument, the thing would be practically inoperative for the purpose of business transmission?

Ans. That would depend upon the position occupied by

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the instrument. If it is placed in a vertical position, as usual, certainly their operation would be easily impaired. If placed in a horizontal position they might be so adjusted without additional weight than that of the carbon itself, as to operate quite as well as they do with their present construction.

X-Int. 34. Don't you also know that before 1876, that for the purpose of circuit breaking, platinum electrodes were the best, and that carbon electrodes for that purpose were the worst of any known substance, or generally speaking, the worst?

Ans. Before giving an affirmative answer, I should modify the questson by saying gold instead of platinum. Prior to the date of the invention, the properties of carbon in this respect were very little understood, and no doubt platinum was regarded as the best substance available for the purpose indicated.

X-Int. 35. And wasn't it best because in a circuit breaker there is a spark at each rupture, and platinum is preserved during that spark better than other material known for the purpose?

Ans. No doubt that was the case.

X-Int. 36. And wasn't it true then, and isn't it true now, that for the purpose of circuit breaking carbon is about the worst material, because it is destroyed rapidly by the spark, resulting from the rupture of the current?

Ans. The answer to that question must depend. To take an extreme case, with such circuit breaking as is employed by the electric light, platinum no doubt is very rapidly distributed, and the width of the break increased until finally the circuit will be broken down entirely.

X-Int. 37. I take the familiar case of the Morse telegraph, in which the circuit is made and broken by the operator's hand, either directly or indirectly. Wouldn't carbon be just the worst material to make the electrodes with in that case?

Ans. It certainly would not be good material.

X-Int. 38. Do you know of anything worse than carbon

to be used as electrodes in that kind of circuit breaker? If you do, name the material, and how you found it out, among those which have been practically used for the transmission of electric currents?

Ans. Carbon would certainly be very bad material. I should hardly know what would be less appropriate for the contact points of a Morse key.

X-Int. 39. And if Mr. Reis meant his machine to operate as he says—that is, to make and break the electric current at each air wave—wasn't carbon just the worst material for that purpose, and platinum the best?

Ans. I don't think so. The circumstances of breaking the current in the two cases are not the same, and therefore any inference from telegraphic transmission applied to telephonic apparatus would be practically valueless.

X-Int. 40. I haven't asked you about what you think the Reis machine is capable of doing under proper conditions. I have asked you the question, and I repeat it, suppose Reis to have intended what he said, namely: to break the electric current at each air vibration, wasn't carbon the very worst material to be used for electrodes, and platinum the very best at that time?

Ans. In answer to the question, I must add to its scope, or answer it untruthfully. No doubt Reis says his apparatus operates by an interrupted current, but he just as emphatically tells how to use that apparatus so as to break it, as he believed, in a way that would successfully transmit speech, namely: by speaking not too loudly, by singing gently in the presence of the transmitter. So that while he uses the expression implying that he believed the circuit was broken, it is still very doubtful if his success was at all due to the breaking of the circuit, and, therefore, with that understanding, I should say that platinum was poorly suited to his purpose—not as the question implies, the best.

X-Int. 41. I will try again. Suppose it to be true that Reis intended his transmitter to break the electric current at each wave, then wasn't it true that platinum was the best material for the electrodes, and carbon the worst?

Ans. On the hypothesis implied in the question, undoubtedly.

X-Int. 42. When you said that you were trying experiments on an apparatus for the transmission of speech in your examination in New York heretofore, was that apparatus the contrivance in which notches are filed on the perimeter of a wheel, and by the turning of that wheel in contact with an opposite electrode, electrical impulses were transmitted to the receiver in imitation of human speech?

Ans. Substantially.

X-Int. 43. I understand that a wheel has been produced with a notched perimeter about thirty inches or more in diameter, with about eight hundred notches filed in its edge, and that by turning, an ejaculation—"Hello"—is produced at the other end of the receiver. Is that the thing that you refer to when you say you have seen such experiments?

Ans. One of the things.

X-Int. 44. Now, don't you think, as an experimenter and scientist, that if you were trying to find out whether a carbon microphone is a circuit breaker or transmits speech by really maintaining the current at all times with more or less strength without rupturing it, you had better devote your attention to the carbons themselves, instead of trying to contrive a wheel in which you can file notches in imitation of the phonograph and get an ejaculation like "Hello" from it?

Ans. If that were one's object. If the object set forth in the question were the only one, possibly a direct attack upon the problem might be preferable. This, however, is not the object of that experiment, and the question misjudges the intention, to a very large degree, of those who are conducting the experiments.

X-Int. 45. MacDonough is the man who has been conducting the experiments, chiefly, isn't he, and has made this "Hello" wheel?

Ans. I have had no part in the construction of such a wheel; I have merely heard its performance. The experi-

ments in which I am engaged are not those involved in the question. MacDonough is the man, as I understand it, who made this wheel.

X-Int. 46. Then explain and describe your experiments so that, in case it should be necessary, they could be repeated?

Ans. Such an explanation, I think, would be premature, inasmuch as they are not finished.

X-Int. 47. Well, supposing when you finished them you could find out by properly arranging notches in the perimeter of wheels, you could imitate human speech in a receiver by a current ruptured by means of those notches, would you then conclude that the apparatus known as the Bell telephone does not transmit speech by reason of what is called undulatory current, whose strength is in practical unison with the strength of the air waves used to excite the transmitter?

Ans. I should conclude from such experiments, if successful, that the unproved assertion that speech can be transmitted in no other way than by continuous current must be set aside as wholly untrue; and, in my opinion, such will be the outcome of our experiments.

X-Int. 48. Will you be good enough to tell the Court where that unproved assertion forms any part of the patent in controversy here, or of the issues in this case?

Ans. Only in that it underlies the general claim for the method, as I understand, in the patent under which this suit is brought.

X-Int. 49. Then I return to my question. Supposing you can get "Hello" through a wheel notched in its perimeter with eight hundred notches, does that prove, or don't it prove, that the transmission of speech through the Bell telephone is done by circuit breaking?

Ans. In my opinion, it will tend to prove that the assumption that that must be a continuous current is without warrant. It does not prove that when legitimately used the Bell telephone, with the Blake transmitter, does or does not break the circuit.

X-Int. 50. Wouldn't it be just as true as any physical certainty with which you are acquainted that the Bell telephone, by which I mean the thing described in his two patents, does operate necessarily by an undulatory current, the form of whose waves substantially correspond with the form of air waves used in transmitting speech, even if you can produce a wheel with notches so arranged as to make it produce an imitation of the human voice in the ejaculation "Hello?"

Ans. As to the undulatory current as distinguished from pulsatory and intermittent currents it ought to be said that all we know, and all any scientific man in any part of the world can know at the present time, is that there is a general accord in the periodicity and intensity with the vibrations produced by the voice in spoken language, and that that general accord existed and does exist still in those earlier forms of the telephone as of later ones, and that it is immaterial whether such correspondence follow from the direct action of the voice, or from the action of the voice upon an apparatus whose indications are copied and thus by an indirect method enable us to analyse what does occur, instead of conjecturing what may occur between distances so minute as not to be measured.

X-Int. 51. If you continue to refuse to answer a direct question which has no connection, whatever, with Reis and other things which you drag into your answer, of course I shall cease the cross-examination. I will give you one more opportunity to reply, and if you refuse to take it, I shall stop. Wouldn't it be entirely true that the Bell telephone as described in his two patents, does transmit speech by a closed circuit in which the electric current is made to correspond sufficiently with the undulations of the air waves to copy their form, notwithstanding it might be true that you can get "Hello" artificially created and transmitted by filing notches in a wheel?

Ans. Undoubtedly the circuit is never broken, and the operation is, in the Bell instrument alluded to, described by him as undulatory; and I have no disposition, nor do I be-

lieve it proper, to draw any inference as to the action of those instruments from the behavior of the notched wheel in question. Certainly, in the magneto-telephone the current may be undulatory, understanding, in general, by that term periodical; or it may be interrupted as it is when the movement of the diaphragm ceases. I do not see how any inference can be drawn as to the behavior of Bell's instrument from the experiment with the wheel.

X-Int. 52. Again; do you see how any inference can be drawn from the wheel experiment which would modify or change the generally received opinion that in a transmitter in which the strength of the current is varied and not broken in the external circuit, the operation is substantially the same as it is in the magneto machine?

Ans. I do see a decided inference that can be drawn. In my opinion it is one of great value.

X-Int. 53. I take now the liquid transmitter of the Centennial in which one pole being immersed in a liquid bath no motion is felt by the vibration of the diaphragm, and the strength of the current varied accordingly. Would you say to the Court that if it could be shown that a notched wheel would create the ejaculation "Hello" that that liquid transmitter operated by circuit breaking and not by varying the strength of the current?

Ans. I should be very far from making any such assertion.

X-Int. 54. Would you assert that it tended to any such conclusion?

Ans. I should not.

X-Int. 55. Again; suppose it to be true that the microphone transmitter operates by maintaining a constant current of electricity but by varying its strength in consequence of the fact that that current is interrupted through a portion of the opposing surfaces while it remains flowing through the residue, would you say that the fact that your wheel could ejaculate "Hello" proves that that microphonic apparatus does not operate by continuous current, varied in accordance with the variations of the air waves produced by the voice?

Ans. The answer is obvious in the hypothesis. If the

circuit is not broken as the question implies, of course, we could not infer from any other phenomena that it was broken.

X-Int. 56. Then, will you tell the Court how it is of the least consequence for the determination of this cause, that you should spend months in trying to find out whether a wheel can be so filed as to ejaculate "Hello," or some other sound resembling the human voice?

Ans. I will endeavor to tell the Court. It is asserted that the Reis instrument and others which have been brought into this case, operate by making and breaking the circuit. Such language has been employed by their inventors as would imply that they held the opinion current at the times of their inventions, such breaking did occur. It is also asserted by the experts testifying in these cases and by others, that no apparatus which operates by making and breaking the current can possibly transmit speech. If now, an apparatus which demonstrably does make and break the current, no matter whether actuated by the human voice, or whether made by reference to a copy of some action which resulted from the human voice, if such apparatus so breaking can and does actuate a telephonic receiver so as to reproduce substantially the same sounds as were uttered to the instrument making the copy, and all by means of an interrupted circuit many times interrupted, then the position that a circuit breaking apparatus must be inoperative falls to the ground; for, plainly having once proved that articulate speech can be recognized in this way, it is certainly not evident why an apparatus—the microphone transmitter, if you please—may not be so operated as to do the same thing, namely, transmit articulate speech by making and breaking the current.

X-Int. 57. Allow me to correct your assumptions. In the testimony of the complainants it is admitted that articulate speech can be transmitted through an instrument in which the circuit is broken during transmission. It is also admitted that the Reis machine, by proper manipulation, and with the knowledge of the art discovered by Bell, can

be made to transmit speech, which it does without circuit breaking, and not in consequence of circuit breaking. It is also said by the complainants' experts that whenever the circuit is broken in an apparatus in which human speech is being transmitted, and the battery thereby instantly let on and off, the speech by that circumstance is impaired, and if repeated enough is destroyed. Now, will you tell the Court which one of those statements is proved to be untrue by the production of a wheel with notches on the perimeter so filed as to make the receiver ejaculate "Hello?"

Ans. Of the specified statements employed in the question perhaps no one; but the result of such demonstration as, in connection with Professor Young, I hope to make, will be, I think, to show that the sole effect produced in the receiver by which articulate speech is transmitted is due to the continuance of the current with the interruptions in it. While the current continues, whatever varying strength it may have will be due to the induction on the line and other causes entirely outside the usual varying resistance, which it is assumed operates in the Blake transmitter, and in others of its class, and in which absolute discontinuity of the circuit is many times repeated, in order that by the use of large surface of contact and proportionally large spaces of discontinuity, we may produce a condition of things such as we suppose may occur in the action of the microphone, but within limits too small to be recognized.

X-Int. 58. Is it your expectation that you will overturn the hypothesis propounded by Sylvanus P. Thompson, and acquiesced in by Professor Young and yourself, that the microphone operates by reason of diminishing the number of points through which the current is flowing, while at the same time it continues to flow through some points of contact?

Ans. I should be open to conviction by the result of experiments.

The question is objected to by defendants' counsel as not properly conveying the result of Professor

Young's answer to the inquiry concerning Professor Thompson's opinion.

X-Int. 59. I have no doubt you are open to conviction, as all scientific men must be about any question. I ask you whether you expect that your experiments with your wheels, or otherwise, will prove that microphone transmission is not performed in the manner described by your associate, Thompson; namely, that a portion of the opposing surfaces ceases to conduct, while the residue continues to conduct, and thereby varies the strength of the current passing through the joint?

Ans. No such object has been proposed, but I do expect to ascertain something with reference to the relative distances between which the microphone transmitter becomes operative and inoperative. I further expect—hope, at least—to get some light on the question, whether the change of temperature is not a more important factor than the change in contact; and there are reasons in my mind which go to show that in change in temperature the points of carbon contact would be entirely adequate to produce all the results found in microphonic transmission. I certainly do not expect the experiments with the wheel to decide that point, as they are evidently not adapted to do so.

X-Int. 60. And if you should become satisfied that the change in the temperature at the joint produces the effect, would you conclude that that effect was a make and break of the electric current, or a variation in the conductivity occasioned by the variation in the temperature?

Ans. It might be partly both, and doubtless would be. Thus, if a few points were in contact and were heated, thereby changing their dimensions, their effect might be to thrust others out of each others' range, and so diminish the current due to them. I should not expect to separate by simply sharp lines of demarkation the two effects from each other.

X-Int. 61. Then, are you trying experiments in expectation that you will find the change of temperature at the joint to be an efficient factor in the problem of varying the strength of the current on the line: that such change will

vary that current by breaking it, and, that, therefore, it will be established that microphonic transmission is done by making and breaking, instead of by varying the strength of the current?

Ans. Such a position would not be, as the question seems to imply, observed, but, on the contrary, well known experiments may be cited in which sudden change of temperature at the contact points did result in the absolute separation of the parts in contact. I may cite the well known Trevalian experiment, in which a musical note is produced by rapidly forming and distributing pimples that rest on a block of cold lead, by coming in contact with heated metal alternately on one side or the other. It is by no means certain that rapid changes of the temperature, due to the passage of the current at the microphonic contacts, do not in part act in the same way. Indeed, good authority could be cited which holds this opinion.

X-Int. 62. In the Trevalian experiment the hot bar is caused to tilt first one way and then the other by the action of the heat. Would you say that microphone contact, supposing heat to be generated, would physically operate in that way on an ordinary microphone transmitter, or on two blocks of carbon laid one on top of the other, which have been brought to your attention heretofore in these cases?

Ans. Something very analogous does occur in the case of the blocks of carbon, as is evident from the fact that when the loose contact is simply a block of carbon lying by itself across two other blocks, and a current is made to pass between them, a clear musical note is produced, showing that the block is thrown into vibration, which is also further proved by attaching to it a mirror and causing it to reflect a beam of light in such a way that the excussion of the beam is received upon the screen, and not only points out the actual movement, but shows the range of it.

X-Int. 63. And during that performance is the electric current broken so that it ceases to flow over the line?

Ans. That is just the question at issue, and can only be determined by further experiments.

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X-Int. 64. And don't you think that the right way to try that experiment is to apply the test to the current actually flowing through those blocks, instead of making wheels to say "Hello?"

Ans. I have already answered that; I do not expect any light from the wheel on this subject.

X-Int. 65. You also said that Baxter varies his strength of current by varying the resistance external to the line wire. Bell's, you say, varies it by magneto-induction. Does not Bell point out in his specification that the undulatory current may be produced by varying the external resistance on the line, and indicate a liquid transmitter as one means of doing it?

Ans. He certainly shows a number of well-known examples in which the current is varied, and among them has mentioned that the liquid may be so employed, but has shown no apparatus to do it.

Re-direct examination by Mr. Keasbey:

Re-dir. Int. 1. Having read to you cross-question No. 22, concerning Professor Thompson's statement and Professor Young's opinion as to the view of Professor Thompson thus stated by the counsel for complainants. I now read you the question to Prof. Young, relating to Thompson's view, and his reply, namely: "X-Int. 26. I read to you from the testimony of your associate expert, Sylvanus P. Thompson: I hold, and still hold, that all that pressure can do at a so called microphonic contact is to increase or diminish the number of particles of the one surface that may be in contact with the particles of the other surface, and that, therefore, it is strictly true to say, that the effect of talking to a microphonic or loose contact, is to open or close the circuit more or less." Is that the same that you mean when "you talk about breaking the circuit in a microphonic contact, or is it something else?" And to this question Professor Young answered: "I think the theory of microphonic action suggested by Mr. Thompson is a very probable one—perhaps the most probable of any—but I do

not undertake to say that I am certain of its correctness as against that of some rival theories."

To the passage thus read by counsel to Professor Young from Professor Thompson's testimony, was added this: "Seeing that the resistance will depend upon the number of molecules which touch one another, and form bridges by which the electric current can pass from one of the contact pieces to the other, and I say that it is a matter of clear inference from Reis's own publications that he intended his transmitter to act as a contact instrument—to open and close the circuit, strictly in proportion to the vibration, not necessarily breaking completely or making completely the circuit at any instant, and I think that it is quite clear that Reis intended to produce articulate speech by this operation, which he did not call, make and break, but which he called, opening and closing the circuit, and which he also called, interrupting the current."

Now, having read this corrected statement of Professor Thompson, with the answer of Professor Young to it, have you anything to add to your remark as to the views of Professor Thompson, as stated to you by counsel?

Ans. I agree with my colleague, Prof. Young, in the view that the explanation given by Professor Thompson, and held by others, is a factor at least, and perhaps a very important one—the most for aught I know—in the theory of telephonic transmission.

Re-dir. Int. 2. Do you regard the magnetic pull, as it is called in the Baxter instrument, as necessary for the operation of the instrument for the transmission of speech?

Ans. I do not.

Re-dir. Int. 3. Without that addition is there any difference in the principle of its operation from the Reis transmitters and the ordinary form of microphone transmitters?

Ans. I think there is not.

Re-cross examination by Mr. Dickerson:

Re-cross Int. 1. Professor Thompson makes this statement: "Seeing that the resistance will depend upon the

number of molecules which touch one another and form bridges by which the electric current can pass from one of the contact pieces to the other." Is it, so far as you know, assumed by properly instructed scientific men in these days, that molecules touch each other?

Ans. In the absolute mechanical sense I suppose not, and yet I am not sure that mode of expression used by Professor Thompson is not perfectly legitimate. It certainly is as much so as to talk of billiard balls touching each other.

Re-cross Int. 2. Do you suppose that the electrical conductivity between opposite surfaces, depends upon the contact of the molecules in the opposite surface with each other?

Ans. In the same way as I answered the last question. I would say that what is now called among scientific men molecular contact, undoubtedly occurs, by which I do not mean to say that if there be hard molecular nuclea which are unyielding, that they are ever brought in contact so as to be continuous, for this would preclude all elasticity.

Re-cross Int. 3. If the molecules of the opposite surface were brought into anything like contact with each other, those opposite surfaces would adhere, would they not?

Ans. It may be presumed so.

It is agreed between counsel of the respective parties hereto that Mr. Fred. M. Ott shall act as examiner in Philadelphia and Harrisburg; and that the taking of testimony before him shall be begun at Philadelphia on Monday, the second day of February, 1885, at the Continental Hotel, at twelve o'clock noon.

The further taking of this testimony was then adjourned to Saturday, January 31st, 1885, at 160 Broadway, New York, at 11 o'clock a.m.

CORRA N. WILLIAMS,
Notary Public and Special Examiner.

160 Broadway, New York City, Jan. 31, 1885.

Examination continued.

Present—E. N. Dickerson, Esq., counsel for complainants; A. Q. Keasbey, Esq., counsel for defendants.

Henry E. Waite presents himself for cross-examination.

Cross-examined by E. N. Dickerson, Esq.:

X-Int. 1. Are you the same Henry E. Waite whose name appears in the pamphlet which I now show you, entitled The Molecular Telephone Company of New York, 67 Wall street, New York?

Ans. I am.

X-Int. 2. That pamphlet is an advertisement of the business of the Molecular Telephone Company, isn't it?

Ans. It is.

X-Int. 3. You appear in that pamphlet with the office of electrician, having for consulting electricians Dr. Channing, of Providence, Professor Morton, of Hoboken, and Professor Chandler, of the School of Mines of New York. Is that the organization under which that company is working its electrical department?

Ans. It appears so from the pamphlet.

X-Int. 4. I notice in that pamphlet that you are sometimes styled "Professor Waite" and sometimes styled "Dr. Waite." In what college or institution are you a professor, and what is the title of the professorship which you occupy?

Ans. I am not a professor in any college. The name was simply in the writing; somebody called me that.

X-Int. 5. From what institution of learning, science or medicine did you receive your diploma of "Doctor," and is it "D.D.," "LL.D." or "M.D.?"

Ans. It is neither. I was attending the University College of New York City, and there obtained the name of "doctor;" and, as they call all the students there "doctor," that is how it originated, and it has clung to me ever since. The University is on 26th street, New York.

X-Int. 6. You were the patentee, either alone or in association with Mr. Bartlett, of the different contrivances which are used by the Molecular Company, are you not?

Ans. Yes, sir.

X-Int. 7. That company is a defendant in a suit by the Bell Telephone Company, charging them as infringers, are they not?

Ans. Yes, sir.

X-Int. 8. You are also the patentee of about twenty patents in telephones, are you not?

Ans. Yes, sir.

X-Int. 9. There are about five hundred patents for improvements in telephones since the date of Bell's invention, are there not?

Ans. I don't know the exact number; but a very large number.

X-Int. 10. If I understand the drift of your deposition, it is that Mr. Bell did not make any new invention in the art of transmitting speech when he exhibited his undulatory current theory, and an apparatus for carrying it into effect. Is that what you mean?

Ans. I mean to say that his 1876 patent was not a telephone, and was not so described.

X-Int. 11. When Mr. Bell exhibited his apparatus at the Centennial in 1876, was that an exhibition of a new thing, or was it known before that time, as far as you know, that speech could be transmitted over a wire by means of an undulatory current of electricity whose form should agree substantially with the form of the air waves?

Ans. It was known before that time that speech had been transmitted by electrical current, whether by undulatory or other means I don't know; but speech had been transmitted.

X-Int. 12. But so far as you know, had it been known before 1876, that speech could be transmitted by means of an undulatory current of electricity whose form should agree with the form of the air waves engaged in producing the speech?

Ans. Well, that is not known at present, whether it is undulatory current or not. It is merely a name.

X-Int. 13. Then, you think, that speech is not transmitted by the Bell telephone by means of making the current of electricity in form substantially with the air waves that are engaged in producing speech?

Defendants' counsel requests that the witness shall be told what is meant by the Bell telephone in the question.

Mr. Dickerson: If he don't know, it is too late for me to tell him.

The witness: Answer: I do; so far as the 1876 patent is concerned.

X-Int. 14. I havn't asked you anything about the 1876 patent, I asked you about a Bell form of magneto-telephone, commonly called the Bell telephone, and with that explanation, I ask you whether speech is not transmitted through that instrument by means of making the current of electricity conform substantially with the air waves that are engaged in the act of speech, as you understand the subject?

Ans. As I understand the subject, no one knows. It varies the electro-motive force in a circuit in the magneto-telephones and causes the armature to vibrate as the electro-motive force is varied; but as to whether the electric current itself vibrates or undulates, no one knows as far as I can ascertain.

X-Int. 15. Then, so far as you understand the subject of electricity, you think it is not true that speech is transmitted in that instrument by reason of the fact that the electric current is made to conform with the undulations of air that are produced by speech?

Ans. As I before stated, no one knows, and there is no way of proving the effect it has on the electric current. It is merely a name given for the theory advanced.

X-Int. 16. If you will confine your answers to what you know, and not attempt to state what anybody else doesn't know or does know, you will probably get along better. I am not asking you about what anybody else knows, but

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what you know or believe. Do you believe that the transmission of speech in the apparatus described is the result of the fact that the electrical current is made to conform substantially with the form of the air waves engaged in speech, or have you no opinion or belief on the subject?

Ans. I have an opinion on the subject. I know that in in some way the current is varied so as to produce vibrations at the other end, somewhat similar to those at the transmitting end, but how it is done I do not know.

X-Int. 17. You have taken a great many patents, one as late as the thirteenth of January of this year on a telephone receiver, patent No. 310,751, which I now show you. Do you consider that an improvement upon the telephone receiver in common use, called the Butterstaff receiver or the Black-Handled receiver?

Ans. No, sir; I do not. This is simply a common form merely to illustrate the arrangement of the parts.

The specification of said patent No. 310,751 is offered in evidence, and marked Exhibit No. 1 for complainant of this date.

C. N. WILLIAMS,
Notary Public.

X-Int. 18. Didn't you know when you applied for that patent that it was no improvement on the ordinary Bell receiver in common use, and that the patent was a mere sham?

Ans. No, sir.

X-Int. 19. Then, will you tell the Court wherein the improvement consisted, as you believe?

Ans. I can. In the first place I use a wooden diaphragm which is attached to an armature at the other end of the magnet by a rod of unmagnetic material. The armature which is in front of the poles of the magnet is not as susceptible to the amount of induction as an iron diaphragm would be. For that reason, you get less induction and consequently better speech, better articulation.

X-Int. 20. Then you mean to say, do you, that placing

the diaphragm at the opposite end of the magnet from the armature, and connecting the armature to it by a rod instead of connecting the diaphragm and armature together at the magnet end, improves the speech at the receiver?

Ans. It does, for a number of reasons. The rod which passes through the wooden diaphragm is very small, and, therefore, takes up a very little space and does not interfere with the vibrations that it would if an armature of sufficient size was fastened to it.

X-Int. 21. Then it is an improvement on the ordinary Bell telephone?

Ans. I didn't say that.

X-Int. 22. I also observe that you have a patent, No. 286,875, in which you cut out a portion of the metallic diaphragm of the Bell receiver, and leave a straight band of metal across the pole of the magnet instead of the circular disk. Do you consider that an improvement upon the ordinary Bell receiver in question?

Ans. I am not comparing any of my patents to Bell's.

X-Int. 23. I haven't asked you to compare your patents to Bell's. I ask you whether this modification of the ordinary hand receiver used in telephones generally, in which there is a straight magnet, a coil around the end of it, with an electro-magnet and a diaphragm of metal, by which modification you cut out a part of the receiver and leave a strip (letter E in your patent) is, in your judgment, an improvement upon the ordinary receiver, or whether it is not only a sham patent for the purpose of exhibiting an entirely immaterial modification?

Ans. As regards the sham patent, this patent will work commercially, while Bell's patent of 1876 never did work, and is a modification of Reis and Van Der Weyde.

X-Int. 24. I think you would get on better if you would answer my question without trying to introduce arguments or statements that are not involved in the question. I will try again. In this patent you say you have invented a new and useful improvement in receivers for telephones. Now, doesn't that refer to the ordinary telephone receiver in

common use generally made of hard rubber with a metallic diaphragm, with a straight magnet and electro-magnet, with a narrow coil at its end, of which this picture in your patent is a very close imitation?

Ans. Not necessarily. The parts that are brought into action—violently brought—and the strip in the place of the diaphragm are somewhat different from the Bell instrument.

The specification of said patent No. 286,875 is offered in evidence and marked Exhibit No. 2 for complainant, of this date.

C. N. WILLIAMS,
Notary Public.

X-Int. 25. The only change is, that in the place of the circular disk of thin metal you have cut off from each side of that disk, leaving a straight strip across the pole of the magnet letter E in your drawing; isn't that so?

Ans. What are you trying to get at? If you wish to compare it with that of a so-called Bell instrument—as a comparison—I can give you a very quick comparison, if you wish. I will answer the question if I know what you want.

X-Int. 26. I am not going to be questioned by you. I am conducting the examination, and I think you will answer the question before I stop.

By Mr. Keasbey: Answer the question, if you understand it.

Witness. The question is not properly put. I understand the question. I can answer it.

Ans. Yes, sir.

X-Int. 27. And having done that, did you suppose that you had improved the telephone receiver, or that there was any change in the mode of its operation introduced by the circumstance that the diaphragm was reduced from a circle to a straight strip in front of the magnetic pole?

Ans. Yes, sir; it gave me a greater volume of sound; the amplitude of speech was greater.

X-Int. 28. Then you mean to swear, do you, that the receiver talks louder than if the disk were continued all the way around?

Ans. Yes, sir; that one did so. I might state there is a great difference in the receivers being made as near alike as possible. Some are much better than others.

X-Int. 29. The question I wish answered is, whether you believe that that particular thing shown in your patent, all other things being equal, talks louder than if the diaphragm were a complete disk instead of being a portion of it?

Ans. As far as I have gone, I think it is.

X-Int. 30. Then it is an improvement upon the ordinary telephone receiver, as you understand it?

Ans. Yes, sir.

X-Int. 31. Do you use such things in your company as a receiver, practically; or has it been introduced by you into use practically?

Ans. No, sir.

X-Int. 32. Too valuable, I suppose, to use. You don't think it is too valuable to use, do you?

Ans. If I could place the value on it which Bell placed on his 1876 patent, I might think so.

X-Int. 33. In your molecular telephone circular, it is stated that the cork diaphragm of the transmitter, to which the carbon microphones are attached, is not a vibrating diaphragm, but that it acts in consequence of what is called molecular action. Don't you know that that statement is false?

Ans. No.

X-Int. 34. Then, you believe it to be true, do you, that the cork diaphragm of what is called the molecular telephone does not vibrate when it is spoken to?

Ans. It vibrates molecularly, but not mechanically.

X-Int. 35. That diaphragm is about six inches or more in diameter, isn't it?

Ans. Yes, sir; about five or six.

X-Int. 36. It is a thin sheet of cork, isn't it?

Ans. Yes, sir; a quarter of an inch thick.

X-Int. 37. And then you mean to say, do you, that when the air waves beat upon that it does not vibrate bodily, but that all that takes place is that the molecules inside of it have a molecular motion. Do you really mean to swear to that?

Ans. Yes, sir; to the best of my knowledge.

X-Int. 38. To the best of your knowledge. Have you ever taken the trouble to give that knowledge any information on which you could swear; or is it a guess?

Ans. It is not a guess. We have placed a microphone in the center of a piece of cork, about two and a half inches to three inches in diameter, inside of a cylinder of zinc, and then been able to transmit speech perfectly.

X-Int. 39. The question I ask is whether a disk of cork, a quarter of an inch in thickness, and about six inches in diameter, supported at its edges and spoken to, stands still; or whether it vibrates to and fro under the beating of the air waves? Will you answer that question?

Ans. The action is molecular action. The diaphragm is not fastened at its edges. It rests loosely on supports, and I have never been able to discern any vibration of it, and all of my experiments have proven to me that it is molecular action—that is, a vibration which does not vibrate out of its position, or vibrate bodily.

X-Int. 40. Then, if a diaphragm of that kind had an armature attached to the opposite side of it in place of your carbon microphones, and it were set up in place of the diaphragm of the ordinary magneto-transmitter, it would not move to and fro so as to excite an electric current in the electro-magnet as you understand it, would it?

Ans. If arranged as we arrange it, I don't think it would.

X-Int. 41. That is to say, supported at its edges by some frame, with an armature in the middle of it, and spoken to from above, in your opinion that armature would not move, so that it would not be possible to transmit by the magneto method with a diaphragm like that. Do you really mean to swear like that?

Ans. No, I do not.

X-Int. 42. Isn't it necessary that that armature should move to and fro in order to produce the current required?

Ans. It is necessary that there should be a movement of some kind.

X-Int. 43. To and fro?

Ans. I have not so sworn.

X-Int. 44. Then you think it should move sidewise and not to and fro between the poles of the electro magnet?

Ans. It wouldn't be very apt to move sidewise.

X-Int. 45. Don't you know as well as you know anything that in the ordinary magneto telephone the current is produced by the fact that the armature moves to and fro in front of the pole of the electro magnet?

Ans. I do.

X-Int. 45. And don't you know as well as you know anything that if that diaphragm were made of cork instead of metal or bladder or some other material, the effect would be produced by the circumstance that it did move to and fro when spoken to?

Ans. There could be a current generated by simply a change of the molecules in that armature.

X-Int. 46. Won't you answer the question without suggesting some other possible mode of operation which your imagination conceives?

Question repeated.

Ans. Yes, sir.

X-Int. 47. But when you use it in what you call the molecular telephone, you think it does not vibrate to and fro when spoken to. Do you mean to swear to that?

Ans. In some forms of our transmitters it may vibrate as you state.

X-Ins. 48. Do you believe that there is any practical transmitter in which the diaphragm supporting the microphones does not vibrate to and fro when spoken to, and if so, point out that instrument which you say does not vibrate and describe it?

Ans. I think all microphones that are attached to a dia-

phragm may be disturbed by a vibration of those diaphragms.

X-Int. 49. Won't you just change the tense of that verb and say that they are disturbed by the vibrations of that diaphragm when it is spoken to?

Ans. No, sir.

X-Int. 50. Then describe the microphone transmitter in which the diaphragm does not vibrate when it is spoken to, in order to produce the variation of the current through the microphone, and tell us how you know it does not, and under what circumstances you found it out?

Ans. In one of the patents of the Molecular Company, taken out in 1880, there is an embedded microphone in a block of cork which I do not think vibrates mechanically when used.

X-Int. 51. Is that instrument used as a practical operative telephone, and if so, where is it in use?

Ans. It is not in use at present. It has been used.

X-Int. 52. Could you refer me to the number of that patent?

Ans. It is No. 228,824, June 15th, 1880.

X-Int. 53. In any of those that are in practical use, do you know of any one, whether you call it a molecular telephone or any other name, in which the diaphragm does not vibrate to and fro under the impulse of the air waves when spoken to, and if so, name the instrument, and where it can be seen, and how you know that it does not so vibrate?

Ans. I don't know of any way to prove that the diaphragms of the instruments do not vibrate. The only explanation that I have to make of our instrument is this: Rudolph Koenig, of Paris, a celebrated physicist, in explaining as to the action of our instrument to the president of our company, stated that the cork absorbed the sound waves and they were conveyed by molecular action through the microphone. To illustrate this he took a tuning fork which he set in vibration by drawing a bow across it and held it towards the wall. The sound was reflected back

with great force. He then passed it in front of some curtains that were hanging in front of an alcove, and then the sound was deadened and not reflected back. He stated that the action was the same with a cork in our transmitters.

X-Int. 54. Who gave you all this valuable information that you are now swearing to?

Ans. Mr. Charles F. Livermore.

X-Int. 55. Then it is upon that information, is it, that you are swearing that the cork diaphragm does not vibrate when spoken to?

Ans. We have always claimed that it does not vibrate mechanically but molecularly. Why, a thin piece of cork if it is fastened to the end or edges would be compelled to vibrate the same as any membrane to a greater or less degree.

X-Int. 56. I know you always made that claim, and I am trying to find out from you whether you don't know that it is false, which is the present object of my question, and I now ask you whether if a six inch cork diaphragm a quarter of an inch thick to which the microphones are attached, when it is spoken to it does not vibrate under the air waves which beat it bodily, mechanically, if you choose that expression, and thereby disturb the contacts of the microphones?

Ans. I do not think that it does.

X-Int. 57. That is your present belief?

Ans. Yes, sir.

X-Int. 58. If it were made of segar box or metal or pine board, it would vibrate, wouldn't it?

Ans. Yes, sir; that would be perceptible in the results you get in the transmitter.

X-Int. 59. But, being a cork it don't vibrate; that is your hypothesis?

Ans. I don't say that it does not vibrate. It does not vibrate mechanically as far as I know.

X-Int. 60. Have you ever taken the trouble to attach a bit of mirror to the surface of one of these things and re-

flect a beam of light when it was in action and see whether the beam of light did not spring backward and forward when the diaphragm was spoken to?

Ans. I don't know how I could do it, unless I was speaking to it and reflect a beam of light from it.

X-Int. 61. Then you don't know enough about physics to understand the simple experiment by which the vibration of the diaphragm is made visible?

Ans. In the diaphragm of the receiver there may be no difficulty in doing that, but in a transmitter, especially one that is not more sensitive than ours, I don't see how you could stand in front of it and throw a beam of light from it.

X-Int. 62. I will try to help you. How far off from your diaphragm do you speak to it?

Ans. I speak about two inches.

X-Int. 63. Can't a ray of light be admitted at an angle of inclination from one side and sent out at the other side between your mouth and the diaphragm?

Ans. It can.

X-Int. 64. If the diaphragm vibrate, wouldn't the ray of light show it?

Ans. It would show it very lightly.

X-Int. 65. It would show a very light vibration?

Ans. Yes, sir.

X-Int. 66. You never tried that experiment, did you?

Ans. Not with a transmitter; no, sir.

X-Int. 67. And not trying that, then you rely upon what the president of your company tells you somebody else told him in Paris, is that it?

Ans. Not exactly.

X-Int. 68. What other fact besides this information?

Ans. I really believe the action of any telephone is molecular, myself. I believe the change in the molecules in the diaphragm of the Bell telephone is what produces the sound, as has been demonstrated by using diaphragms of a quarter of an inch, and even of an inch thick.

X-Int. 69. Then, when you published that the Waite & Bartlett instruments differed in their mode of operation

from Bell and Blake by not using any vibratory diaphragm and using a molecular vibrator of compact substance like cork, you were making a false representation of the fact, as you understand it, were you not?

Ans. I didn't write that book.

X-Int. 70. If the fact be as you understand it, that representation is false, is it not?

Ans. Not as I understand it; all telephones operate by molecular action.

X-Int. 71. You understand that the Bell telephone does; what other kind does not?

Ans. What is that?

X-Int. 72. You said that the Bell telephone operates by molecular action, and that your telephone operates by molecular action?

Ans. I said all telephones.

X-Int. 73. If all telephones operate by molecular action, then yours do not differ from all others?

Ans. No, sir.

X-Int. 74. Then the representation that it does differ in that respect is a false representation, isn't it?

Ans. I am not responsible for what that book says. Our instruments do differ from other instruments in their form of construction.

X-Int. 75. But not in the circumstance that they operate by molecular action, as you understand the subject?

Ans. As I understand the subject.

X-Int. 76. In your patent, No. 253,665, you say: "In the apparatus of Reis a flexible membrane or diaphragm was employed, susceptible of mechanical vibration under the action of sound waves, and dependent upon such vibration in the production of the desired result, whereas we employ a floor or plate of cork, wood, felt or other suitable material capable of conveying the disturbance produced by the action of the sound-waves impinging upon its surface to the microphone or molecular action rather than by mechanical movement of the floor itself." When you made

that statement you didn't think that Reis's microphone operated by molecular action, did you?

Ans. No, sir.

The specification of said patent, No. 253,665, is offered in evidence, and marked Exhibit No. 3 for complainants of this date.

C. N. WILLIAMS,
Notary Public.

X-Int. 77. And it differed from all other telephones in the circumstance that it operates by mechanical vibration, whereas all others operate by molecular action, as you now understand the fact, is that so?

Ans. Yes sir.

X-Int. 78. You also said that putting carbon on the electrodes of the Reis instrument was of mere mechanical skill, and required no invention. Was that your opinion when you took your patent, No. 253,665?

Ans. It is merely a patent on a form of construction.

X-Int. 79. Just answer the question. (Question repeated.)

Ans. My opinion is the same—that it required no particular invention—the act of placing the carbons in place of platinum.

X-Int. 80. Did you discover or invent the carbon electrode for the purpose of transmitting speech?

Ans. No, sir.

X-Int. 81. That was an invention when it was made, was'nt it; on which some great reputations have been made in the world?

Ans. Yes, sir.

X-Int. 82. But you think it was mere mechanical skill to do that, do you?

Ans. I think that at that time that if a person was working on a telephone, and could get these carbons as now made, they would use them in the place of metal. In the first place they are cheaper, and in the next place they do not oxidize, and for the reason that they are better for the purpose.

X-Int. 83. Does not carbon oxidize very fast when it is used as a circuit breaker?

Ans. I never used it as an automatic circuit breaker.

X-Int. 84. When it is interposed in a circuit which is broken and closed alternately, does'nt it oxidize very rapidly?

Ans. I never have tried it and don't know.

X-Int. 85. Then you don't know whether carbon burns up in the intense heat of the electric spark?

Ans. I do.

X-Int. 86. That is what we call oxidizing, isn't it?

Ans. Yes, sir.

X-Int. 87. And don't you also know that platinum is used in a circuit breaker because of its refractory nature, and because it resists oxidization?

Ans. I do.

X-Int. 88. Then you think that any man who was making a circuit breaker, would naturally take to carbon in place of platinum, do you?

Ans. It depends altogether on the kind of circuit breaker he was making. If he was using an intense current, it would burn up.

X-Int. 89. You also made the remark in your testimony that without loose contact you could get nothing; there would be no variation or disturbance of the current. Suppose the two carbon electrodes are secured together by a set screw with a positive stirrup or link connecting them so that the contact is absolute, do you mean to say that you can't talk through that and use it as a microphone for the tranmission of speech?

Ans. I do, if it is screwed up tightly.

X-Int. 90. If it is screwed up so that striking it with your finger you can't possibly make it separate or break the current, won't it transmit speech?

Ans. It would if it was in loose contact—that is, to keep tightened so that you could not shake it, and still there is separation.

X-Int. 91. Suppose it was pressed together with a weight of a pound or two, can't you use it as a transmitter?

Ans. That would depend on the size of the piece of carbon.

X-Int. 92. Just define a loose contact as you understand it?

Ans. A loose contact is a contact you could lay fifty pounds one on top of the other, and if they are not screwed down I should call that a loose contact.

X-Int. 93. But if you put on top of the fifty pounds a screw, so that there is contact between the end of the screw and the weight, and there is a stirrup connecting the opposite carbons, then that wouldn't be a loose contact?

Ans. No, sir.

X-Int. 94. Then, that wouldn't talk?

Ans. No, sir.

X-Int. 95. A loose contact, according to your definition, is any pressure at which you can talk?

Ans. Yes, sir.

X-Int. 96. When you screw it up so hard that you can't talk, it ceases to talk. That is your definition, is it not?

Ans. Yes, sir.

X-Int. 97. When these two electrodes are held together in positive contact, and one of them is spoken to and speech is transmitted, as you understand it, isn't that effect due to the fact that there is a variable resistance through that joint occasioned by the circumstance that there is more or less pressure between the two electrodes produced by the air waves beating upon one?

Ans. Yes, sir.

X-Int. 98. And that is a variable resistance transmitter, isn't it?

Ans. Yes, sir.

X-Int. 99. There is an instrument known as the Hughes' microphone, are you familiar with that?

Ans. I am.

X-Int. 100. That was known in 1878, wasn't it?

Ans. Yes, sir.

X-Int. 101. That consists of a rod of carbon supported at

its two ends by cups or sockets of carbon through which an electric current is made to pass, doesn't it?

Ans. Yes, sir; one of his forms.

X-Int. 102. And mounted upon a board. If spoken to, and a telephone receiver is placed in electric circuit, speech is transmitted by it, isn't it;

Ans. His first ones were too delicate to transmit speech, but he modified the form, and then speech was transmitted.

X-Int. 103. By merely speaking to the board on which this thing was mounted?

Ans. Yes, sir.

X-Int. 104. And that was in 1878, wasn't it?

Ans. Yes, sir.

X-Int. 105. Now, will you look at patent No. 252,714, granted to yourself and Bartlett, in which a diaphragm supports a number of radiating rods of carbon, having their opposite ends mounted in sockets of carbon, the current of electricity passing through the joint at the opposite ends. Isn't that simply a number of Hughes' microphones mounted on a diaphragm, so that when the diaphragm is spoken to the microphonic disturbance shown by Hughes in 1878 is produced and speech transmitted just as he transmitted it?

Ans. Yes, sir; it is a modification of the Hughes microphone.

The specification of said patent, No. 252,714, is offered in evidence, and marked Exhibit No. 4 for complainants of this date.

C. N. WILLIAMS,
Notary Public.

X-Int. 106. It is a modification of the Hughes microphone, having, as the drawing shows, four microphones on one side and four on the other, so that the current has sixteen different joints through which it passes; that is it, isn't it?

Ans. Yes, sir.

X-Int. 107. The object of which is to make sure that there will always be a way open for the current?

Ans. Yes, sir.

X-Int. 108. So as to prevent a breaking of the current?

Ans. So as to prevent an absolute breaking of the current.

X-Int. 109. And that particular transmitter is the one which is called the Molecular Telephone, isn't it?

Ans. Yes, sir.

X-Int. 110. And the one in use by the telephone company?

Ans. Yes, sir.

X-Int. 111. Will you tell the Court where the mode of operation differs at all in principle from the published method of Hughes in 1878?

Ans. There is no difference.

X-Int. 112. You were asked about the Baxter instrument, and described it in your direct examination somewhat. Do you mean to say that that differs in its principle and mode of operation from the Hughes microphone or from the Blake transmitter?

Ans. It is the same as found in all battery transmitters with a loose contact.

X-Int. 113. And don't you think that the Baxter instrument adopts means for making sure of preserving the circuit, which are not in a single Hughes transmitter?

Ans. The instrument is constructed on the principle of the various battery transmitters. It comes the nearest in construction to the Blake, being very sensitive; much more so than the Hughes microphone; therefore, if spoken loud against, the current would be broken.

Adjourned to 2 o'clock for lunch.

C. N. WILLIAMS,
Notary Public.

2:30 P. M. Adjourned to Saturday, February 6th, 1885, at the same hour and place.

C. N. WILLIAMS,
Notary Public.

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DEPOSITION OF JAMES W. MC DONOUGH.

160 BROADWAY, N. Y. City, Feb. 14, 1885.

Examination continued before Corra N. Williams, Notary Public and Special Examiner.

Present: Mr. DICKERSON and Mr. STORROW,
Counsel for complainants.
Mr. KEASBEY,
Counsel for defendants.

James W. McDonough, a witness produced on behalf of the defendants, being duly sworn testifies as follows:

Direct-examination by Mr. Keasbey:

Int. 1. What is your name, age and occupation?

Ans. My name is James W. McDonough; I am thirty-nine years old; my occupation is that of electrician.

Int. 2. Where do you live at present?

Ans. I reside in New York at present; I used to live in Chicago.

Int. 3. How long did you live in Chicago?

Ans. I lived there about eighteen years.

Int. 4. What was your business there?

Ans. My business was that of manufacturer of furniture and upholstered goods.

Int. 5. Were you engaged, while in Chicago, in experiments, invention, and practice relating to the transmission and reproduction of vocal sounds and articulate speech by means of electricity?

Ans. Yes, sir.

Int. 6. Did you file in the Patent Office, at any time, an application for a patent for an instrument intended for that purpose—for the purpose of transmitting speech by electricity?

Ans. Yes, sir; I filed an application April 10th, 1876, called a "Teleloge," which name was afterwards altered at the request of the Patent office into a telephone.

Int. 7. Can you produce a certified copy of that application?

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Ans. Well, I suppose I will have to answer that by saying that I can; I havn't it in my hands at present.

A copy of this application, produced and marked Defendant's Exhibit 1, of this date, and put in by consent in place of the original; to have the same effect as a certified copy would have, and subject to the same objections to which a certified copy would be.

Int. 8. Were you examined as a witness in the matter of the interference between Elisha Gray, George B. Richmond, A. E. Dolbear, T. A. Edison, A. G. Bell, E. Berliner, and James W. McDonough, for improvements in telephones at the office of Gridley & Co., in Chicago, on January 20th, 1881, and on the following days, up to and including January 24th, 1881?

Ans. Yes, sir.

Int. 9. Did you produce at that time certain drawings referred to in your testimony, known as McDonough drawing No. 1, receiver; McDonough drawing of August 26th, 1871; McDonough drawing No. 3, transmitter; McDonough drawing No. 4, transmitter and receiver, and have them marked as exhibits in that examination?

Ans. Yes, sir.

Int. 10. I now show you a copy of your deposition taken in January, 1881, with the drawings that you have referred to, and ask whether the statements made in that deposition were and are true, and the drawings there referred to are correctly given?

Ans. Yes, sir; assuming that there are no clerical errors in the copy.

Said copy (being pages 273 to 310 inclusive) is put in evidence as if the testimony had been now repeated and as if the copy were a certified copy of that examination, without objection on the part of the complainants, and marked for identification.

C. N. WILLIAMS,
Notary Public and Special Examiner.

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(This deposition appears in the book of defendant's exhibits in the molecular case, pages 456 to 481 inclusive.)

Counsel for defendants offers the application filed April 10, 1876, with the copies of the correspondence from the files of the Patent Office, and the drawings annexed to the application, which is marked defendant's Exhibit 2 of this date.

C. N. WILLIAMS,
Notary Public and Special Examiner.

The complainants admit the copy and it is agreed that it shall stand as of the same effect as a certified copy would have, and subject to the same legal objections as would apply to a certified copy.

(This application of April 10, 1876, correspondence from files of the patent office and drawings annexed to application, will be found printed in the book of defendant's exhibits in the molecular case, pages 448 to 455 inclusive.)

Int. 11. In your testimony, in the interference case, you brought down the statement of your experiments and the description of your instruments to about the first of July, 1875. Did you at that time leave Chicago for a time and for what purpose?

Ans. Yes, sir; at that time I went off on a vacation of about six weeks.

Int. 12. Did you after your return resume your experiments with the speaking telephone?

Ans. Yes, sir.

Int. 13. With what special purpose?

Ans. Well, before that time I had constructed some instruments with which I had operated for obtaining the transmission of articulate speech and music, and I continued my experiments for the purpose of making instruments which I supposed would be necessary for commercial apparatus—that is, instruments which would have more of the

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commercial form and giving louder speech, and more particularly on the subject of obtaining a louder tranmission of speech as I continued the experiments.

Int. 14. Did you construct any instrument during the fall and winter of 1875 and 1876?

Ans. Yes, sir; I constructed a large number—probably fifteen, fifteen at least—different instruments.

Int. 15. Did you continue to experiment on your former instruments in connection with those made at a later date?

Ans. I did at times use some of the former instruments, or parts of them, with the instruments that were made at later dates.

Int. 16. Have you in your possession any of the new forms of instruments that you made after the first of September, 1875, and before filing your application?

Ans. Yes, sir; I have several of the instruments which are almost in the same shape as they were when used at that time.

Int. 17. What was the first of the new instruments you made?

Ans. About the first of the new instruments I made was the one here on the table. It followed in the month of September, and was used with this big receiver or the original of that big receiver and another receiver which has never been brought into the controversy.

Int. 18. How would you describe that transmitter?

Ans. The transmitter was mounted on a wooden handle or stand, and the body of it was made of brass in cylinder form, and it had a diaphragm of German silver clamped on to it by a ring of brass, and it was fastened to a wooden board by a brass extension which was screwed into the wood and rested upon a piece of leather. In front of the diaphragm was a brass post insulated from the brass cylinder, containing a screw,—an adjustable screw. In the point of this screw there was a hole bored which was intended to contain an electrode which I used for holding all the electrodes that immediately touch the German silver diaphragm.

In the inside at a later time, probably within a month

afterwards, was placed a transverse bar containing an adjustable screw which could be adjusted up to touch the diaphragm, but which was in electric connection with the brass cylinder and the diaphragm, and the purpose of this screw afterwards was the prevention of too wide play of the diaphragm, or, in other words, to limit the motions between the two points, one in front and one behind. These two points were placed very nearly in a line.

Int. 19. What material did you use in the sockets of the adjusting screw for the electrodes?

Ans. I used platinum, iron, German silver, brass, copper —possibly some other metal—and the point of lead pencil,—an ordinary lead pencil. In making it up I had the screw hole made about the size of an ordinary lead from a lead pencil, and knew that that was one of the conductors of electricity.

Int. 20. Did you use this instrument, and with what receiver?

Ans. I used it with the receiver that time that was made in the latter part of June, and another one that was constructed in September some time, and used it at other times after that.

Int. 21. With what results?

Ans. Well, we obtained very good articulation from it. We used it as a speaking transmitter in connection with wires that I had up in the house, and we used it with very good results—very good speech, rather.

Int. 22. Is this instrument which you hold in your hands in the same condition it was in 1875?

Ans. I believe it to be in the same condition with the exception of the little carbon point; I think that was broken at the time.

Int. 23. Did it have the carbon point in use in 1875?

Ans. Yes, sir; a carbon point in the form of a lead pencil.

Int. 24. How is that marked; with what tag at present?

Ans. The tag that it seems to have on here now is, "McDonough Metallic Diaphragm Transmitter of October, 1875."

Int. 25. Was it really made in September?

Ans. Yes, it was made in September.

Int. 26. Have you caused photographic views of these instruments to be made, showing the exterior and interior of the arrangement?

Ans. Yes, sir.

These photographs are produced and offered in evidence and marked Exhibit No. 3 and Exhibit No. 4 for defendants of this date.

C. N. WILLIAMS,
Notary Public and Special Examiner.

Int. 27. Did you make another set of instruments, embracing transmitter and receiver, in the fall of 1875, known as the Tin Drum Pendulum Transmitter, October, 1875?

Ans. Yes, sir; I had them made; they were made for me.

Int. 28. And the McDonough Tin Drum Receiver, October, 1875?

Ans. Yes, sir; I had them made.

Int. 29. Will you describe this set of instruments?

Ans. The instruments originally were intended for both transmitter and receiver, but were used, one as a transmitter and the other as a receiver.

The receiver is the same as it was at that time, with the exception of the wooden stand that carries the magnet, which was lost, and the wire has been wound on the magnet since. It is a new wire.

Int. 30. Describe the transmitter?

Ans. The transmitter is a tin cylinder with a tin end—a duplicate of the tin drum form receiver. The part which acts as a diaphragm is about ten inches in diameter the widest way, and the length of the tin box of which it forms an end is 9 1-2 inches. The receiver is the same size. They are both flattened on one side of the box to enable them to rest without rolling over. A wire was attached to the tin frame of the transmitter, and at a point directly under the electrode was soldered a piece of platinum. The electrode

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was formed of a piece of brass about 2 1-2 inches long and a quarter of an inch—about one-eighth—broad, which hung at a third of its distance from the top by a brass rod, around a brass pivot, which allowed it to swing. This was mounted on a piece of wood and that on a piece of leather, and a screw passed from the back of the tin plate forming the diaphragm through into the wood. The wood and the leather act as an insulator for the swinging of the pendulum electrode. At the end of the pendulum was an adjustable screw with a milled head, and in the end of this screw was bored a hole for the insulation of such electrodes as were used, which were of metal and of pencil points—different metals. There was a wire soldered to the little rod which formed the pivot on which the swinging electrode worked.

Int. 31. Now the receiver?

Ans. The receiver case was of the same size as the transmitter case, and was intended to be a duplicate—one of the other. The magnet had something the form of the iron work of a Jews-harp—the two poles coming within a half an inch of one another. The magnet was wound with wire and mounted upon an L shaped stand of wood, and the adjustment was made by pushing the magnet and wooden frame backward and forward on the inside of the tin can that formed the receiver.

Int. 32. How were the wires connected?

Ans. The wires of the receiver of the magnet were run through a pair of screw eyes. In operation, a battery was put in circuit, and the instruments were placed at different parts of the house, where they were out of hearing distance, and were operated by speaking upon the diaphragm of the transmitter and holding the ear close to the diaphragm of the receiver.

Int. 33. In your experiments with these instruments, what were the results?

Ans. From the experiments with these receivers we obtained some very good articulate speech, but the resonance of the drums was very great, and interfered to some extent with articulation.

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Int. 34. How do your instruments, as they are at present, compare with their condition at that time?

Ans. The parts of the instrument are the same, with the exception of the stand of the magnet, and the wire which is wound on the magnet. Of course, the instruments today are in a very dilapidated state, having been carried around for a number of years.

Int. 35. Is there anything that is reproduced in the instrument except the wooden block which holds the magnet, and the wire which was coiled around it?

Ans. No; except it might be the piece of carbon in the electrode. These pieces of carbon are quite brittle, and get broken very easily.

Int. 36. Have you caused photographs of these instruments also to be made?

Ans. Yes, sir; I have.

Four photographs of these instruments, the McDonough Tin Drum Pendulum Transmitter of October, 1875, and the McDonough Tin Drum Receiver, October, 1875, are produced and offered in evidence, and marked Exhibits No. 5, No. 6, No. 7, and No. 8 for defendants, of this date.

C. N. WILLIAMS,
Notary Public and Special Examiner.

Int. 37. Did you make still another set of instruments of parchment diaphragms?

Ans. Yes, sir; I made another set of instruments which I have in quite a dilapidated state, which were made after that, and at first were used one as a transmitter and one as a receiver, and afterwards used each one both as transmitter and receiver; the original intention was to use it as a transmitter and receiver, and the parts were built with that purpose. At first they were mounted upon wooden posts, but I afterwards changed them and had brass drums or cases put around them for the purpose of trying to exclude outside noises. There were doors put in the drums for the

purpose of getting in at the magnets which had adjustable screws to allow them to be adjusted nearer and farther away from the pieces of iron which were placed on the parchment diaphragms. There are arrangements on these —both of them—for the purpose of tightening the diaphragms and on one of them the iron ring which formed a part of the tightening apparatus has been removed and sent to the patent office, and replaced by a new brass ring; that ring was put into the patent office as an exhibit.

Int. 38. Was there any means in this for adjusting the electrodes?

Ans. Yes, sir, there were. I used on these two instruments quite a number of electrodes in different shapes and those—some of them—have been photographed, and I have them in a little box. They all had some form or method for adjustment, and all lead to the idea of confining the diaphragm between two points by some means or another. The one which was represented in the photograph of one of the transmitters is loose from it now and I have it in my hand. It is a small bar which passes under the parchment so as to come directly under the screw which carried the electrode. This bar was attached to a little Z-shaped piece which carried the adjustable screw at the top by another screw which was fastened underneath the diaphragm. One of the wires run from this contrivance to the binding posts, the other one to a piece of German silver which had a piece of platinum soldered on it, and was fastened directly under the electrode carrying the screw, and was insulated by the parchment from the brass piece.

The other electrodes are in this box, and are shown on the photograph which was made of them. At the left of the photograph, looking from below, is a side and top view of the same electrode.

The next figure, the third from the left looking from below, has lost a screw from it which was formerly there for the purpose of adjustment.

The next two are in very near the same shape that they

were, with the exception that the movable points have dropped out of one.

The sixth piece, which is a small screw with a milled head, has lost its means of fastening to the parchment.

The seventh is of the species of the first, and has two little electrodes inserted in a piece of rubber, and those electrodes have two little eyes to which were fastened the wires running from the transmitter to the battery and to line, &c.; and it also has an adjustible screw, and at one time a little piece of metal which rested upon the two electrodes.

The two last are at the extreme right of the photographic exhibit looking from the bottom, and are electrodes which were attached to the parchment and directly under the adjustible electrodes.

There is one other electrode upon one of the brass drum transmitters or telephones, which is of the same class as the ones last described and the one shown first to the left of the photograph by two views. It consists of a small piece of rubber fastened by a screw to the parchment, and through the piece of rubber and lying on top of the plain surface of it are two pieces of metal, and resting upon them is a circular piece of metal which can revolve, and which has an adjusting screw to tighten or loosen the circular piece of metal.

I think I made a mistake in making a description of the photograph. The two large pieces on the left hand side, looking from the bottom are not different sections of one piece, but are two different pieces placed in different positions to show a section, being of what was nearly the same shaped piece of metal; one standing on the edge and the other on the flat.

Int. 39. Now, have you finished those electrodes?

Ans. I think I have; I have tried to.

Int. 40. Who made the brass work upon these instruments?

Ans. The brass work on these instruments were all made by Mr. T. B. Jeffreys, of Chicago.

Int. 41. Who made that upon the Tin Drum Pendulum Transmitter?

Ans. Mr. Jeffreys made that, too.

Int. 42. What was his business?

Ans. He was a model-maker, and had made some electrical instruments before that.

Int. 43. Did he work near your place?

Ans. His place of business was on the other side of the street, not very far from my place of business.

Int. 44. Have you caused photographs to be made of the McDonough Brass Drum Transmitter No. 1, and the McDonough Brass Drum Transmitter No. 2; and also photographs of those several electrodes you have described?

Ans. Yes, I have.

These photographs are produced, and offered in evidence, being four in number, and marked Exhibits No. 9 and No. 10, No. 11 and No. 12, for defendants of this date.

C. N. WILLIAMS,
Notary Public and Special Examiner.

Int. 45. Will you look at the photographs of these instruments and describe them?

Ans. Referring to the drawing, McDonough Brass Drum Telephone No 1; G H is the wooden frame between which is the brass drum; D is the tightening ring, and C C adjusting screws for the purpose of tightening the parchment D; E is the electrode with wire attached running through the switch. Referring to the drawings, McDonough Brass Drum Telephone, No. 2, on the same page, in the instrument from the left looking from the bottom G H are the wooden frame; A is the brass drum; D is the tightening ring; C the screw—one of the screws for tightening; D E the electrodes; in the one on the right hand side of the page, H is the wooden frame; B the tightening ring, and F the electrode.

Int. 46. Had these instruments means for adjusting the

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position of the magnet relatively to the metal plate attached to the under side of the diaphgram?

Ans. Yes, sir, they both have; they were mounted on a wooden frame, which had a screw on the main head which pressed on the bottom of the wooden frame, by which the electrodes could be raised or lowered, and adjusted towards the piece of iron which was attached to the under side of the diaphragm.

Int. 47. How did you get access in order to adjust?

Ans. There were a pair of doors to each instrument—one in front and one in the back for getting at the works in the interior.

Int. 48. What was done with the magnet used with the June receiver?

Ans. The magnet that was used with the June receiver was one that was formerly used with another instrument, and that was taken off and cut down, and made part of the patent office exhibit when I filed my application.

Int. 49. During your experiments in 1875, did you discover that your magnets, after they had been magnetized, remained magnets for a long time?

Ans. Yes, sir; I know that they were, and that tin piece of rod or the armatures stuck to them very often when there was no current on the line.

Int. 50. Have any of your instruments, made in the year 1875, disappeared?

Ans. Some of them have, yes, sir; entirely.

Int. 51. What was the state of your health in and after the year 1876?

Ans. My health never was very good, and after having returned from Europe, where I went for the benefit of my health, I applied myself to business so closely that I very soon broke down again, and was not well at any time when I was making these experiments. In July, 1875, my health was in a very bad state, and it continued so, so that in the year 1878 I was obliged to give up business entirely; my health isn't any of the best just now.

Int. 52. In preparing your application, which was filed

on April 10th, 1876, which form did you adopt, and for what reason?

Ans. I adopted the form which I had first obtained successful results from in 1875, and which I had made afterwards in several different forms, in which I have shown two electrodes or sets of electrodes, which were used on the Brass Drum instruments in the Fall or Winter of 1875.

Int. 53. Have you caused photographs to be made of the patent office receiver and the patent office transmitter?

Ans. I caused photographs to be made of reproductions of the patent office models that were placed there. The originals in the patent office were burnt up in the fire in the patent office, and we were notified by the commissioner of patents of that, and made up duplicates of the same.

Photographs of the McDonough Patent Office Receiver, April 10th, 1876; and McDonough Patent Office Transmitter, April 10th, 1876, being shown on the same page, are produced and offered in evidence, and marked Exhibit No. 13, for defendants of this date.

C. N. WILLIAMS,
Notary Public and Special Examiner.

The duplicates which are here photographed are not the same which were put in the patent office as exhibits, but are duplicates of duplicates.

Int. 54. Have you the reproductions similar to those placed in the patent office from which the photographs were made now in your possession?

Ans. The reproductions of which these photographs are taken are similar to those in the patent office, with the exception that those in the patent office are mounted upon board, and have a representation of the battery; otherwise, I believe they are the same in size; and I know, as far as any practical difference is concerned, that they are the same.

Int. 55. Have you those now present, and do you produce them for examination?

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Ans. Yes, sir; I have a pair of the models referred to; I am referring, of course, to the second set of duplicates, and not to the patent office models.

Int. 56. Had you ever heard of Mr. Bell at the time when you filed your application?

Ans. No; I had never heard of Mr. Bell at that time.

Int. 57. Had you ever heard of any claim made by him to having invented a telephone of any description?

Ans. No; I never heard of Mr. Bell before.

Int. 58. Had you seen or heard of his patent of March 7th, 1876?

Ans. Not at the time I filed my application.

Int. 59. Where did you get the name of "Teleloge?"

Ans. I made it out of two Greek words on the occasion. I wanted to make a distinction between the word "telephone" and the word "teleloge."

Int. 60. Have any of the parts of the instruments used by you in June, 1875, been made exhibits in the interference case in the patent office?

Ans. Yes, sir; there was a pair of instruments there which were made as duplicates or exhibits, which contained a part of one of either the receiver or transmitter, I don't remember now—of the ring which was used in the June instrument.

Int. 61. Have you reproduced this instrument?

Ans. There is a reproduction of that; yes, sir.

Int. 62. Have you those reproductions?

Ans. There is one set of them here; yes, sir.

Int. 63. Are those made in accordance with those which were filed in the patent office in that interference case?

Ans. I believe they are; they are in all the essential parts.

Int. 64. Have you caused photographs to be made of them?

Ans. Yes, sir.

Said photographs are produced and offered in evidence, entitled McDonough Receiver, June, 1875;

McDonough Transmitter, June, 1875, and marked Exhibit No. 14 for defendants of this date.

C. N. WILLIAMS,
Notary Public and Special Examiner.

Cross-examined by Mr. Storrow:

X-Int. 65. You have referred to an instrument which you say is at the patent office, and which you state to be a duplicate of the model originally filed with your application of April 10th, 1876. Is that the instrument referred to in some certified copies of the papers produced by your solicitor, Mr. Townsend, on the motion in these cases, and printed on pages 212 to 220, inclusive, in the defendant's papers in answer to the motion? I refer to the papers which begin with the certificate, as follows:

"DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

This is to certify that the annexed are true copies of papers deposited in this office, November 1, 1881, relating to the application of James W. McDonough, filed April 10th, 1876, for "Teleloge." These papers have not, as yet, been accepted and applied as part of said application file.

In testimony whereof I, E. M. Marble, Commissioner of Patents, have caused the seal of the Patent Office to be affixed this 15th day of November, in the year of our Lord, one thousand eight hundred and eighty-two, and of the independence of the United States the one hundred and seventh.

E. M. MARBLE,
Commissioner."

Ans. I believe they all refer to the sets of instruments that were sent as duplicates to the patent office.

X-Int. 66. When did you last see the model filed in the patent office April 10th, 1876, with your original application?

Ans. I saw it afterwards, but I could not tell whether it was six months or a year afterwards.

X-Int. 67. Where did you see it?

Ans. I saw it, I think, in the primary examiner's room.

X-Int. 68. Did you go to Washington for the purpose of seeing it on that occasion? If not, what did you go for?

Ans. No, I don't think I went to Washington for the purpose of seeing it. I think I had some other business in New York or Washington at that time.

X-Int. 69. Did you ask the examiner to show it to you, or how did you come to find it?

Ans. I asked the examiner to show it to me.

X-Int. 70. Have any talk with him about your case then?

Ans. I don't think I had any extended talk with him about it, but I think the case was mentioned in some way and perhaps some few words spoken in regard to it.

X-Int. 71. What was the name of the examiner?

Ans. I don't remember now who the examiner was at that time, but I might find out from some of my papers; I might find out the date of my visit even.

X-Int. 72. You have here produced this afternoon a number of instruments from a trunk; where are they kept at the present time?

Ans. Do you mean where are the instruments kept when they are not here?

X-Int. 73. Yes.

Ans. They are kept in the bank vault.

X-Int. 74. What bank and what vault?

Ans. The bank vaults under the building at No. 4 Wall street; I can't tell you the exact title of the bank; in the United Bank building.

X-Int. 75. In the safe deposit vault?

Ans. Yes, sir.

X-Int. 76. In whose name are they stored there?

Ans. They are stored in my name.

The complainants' counsel state that, in order to save the trouble of going to Chicago, if it can be

avoided, they will admit that Mr. McDonough's Chicago witnesses would now testify exactly as they did testify in January, 1881, in the interference case, if Mr. McDonough or his counsel, Gen. Duncan, requested them to make that admission.

SATURDAY, March 14th.

Examination on the part of defendants resumed at the office of C. P. Crosby, 160 Broadway, New York. Present, A. Q. Keasbey, for defts.; G. T. Curtis, Jr., for complts.

At the request of the defendants' counsel the examination was postponed to March 18th, at the same hour and place, with the understanding that if the counsel of complainant shall prefer that another day than March 18 be substituted in place of that day, such day may be substituted without, however, an extension of defendants' time.

Examination of witnesses on the part of the defendant continued at 160 Broadway, March 18, 1885, at 12 o'clock M.

Present: Mr. CURTIS for the plaintiff, Mr. KEASBEY for the defendant.

It was mutually agreed that the examination be postponed until Saturday, the twenty-first day of March, at 12 o'clock, at the same place, with the understanding that if either counsel shall desire the substitution of another day instead of Saturday it shall be so arranged; this agreement being made in pursuance of the stipulation at the last meeting, and not as an extension of the defendant's time.

C. N. WILLIAMS,
Special Examiner.

In pursuance of above stipulation the examination was further adjourned to Thursday, March 26th, 1885, at 12 o'clock M., at the same place.

C. N. WILLIAMS,
Special Examiner.

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IN THE CIRCUIT COURT OF THE UNITED STATES.

FOR THE SOUTHERN DISTRICT OF NEW YORK.

THE AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, ET AL.	In Equity.

IN THE CIRCUIT COURT OF THE UNITED STATES.

FOR THE DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, ET AL.	In Equity.

IN THE CIRCUIT COURT OF THE UNITED STATES.

FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

THE AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, THE PENN OVERLAND COMPANY, ET AL.	In Equity.

Testimony on the part of the defendants in the above stated cases continued before me at my office, No. 721 Broad street, Newark, New Jersey, this 19th day of September, A. D. 1885.

Present:—Messrs. E. N. Dickerson and J. J. Storrow, for complainants.
A. Q. Keasbey, Esq., for defendants.
C. N. Williams, Special Examiner.

John R. Paddock, called for defendants and sworn.

Examined by Mr. Keasbey:

Int. 1. What is your age and place of residence?

A. I am thirty-three years of age, and reside at East Orange, New Jersey.

Int. 2. What is your business and occupation?

A. Instructor in physics and chemistry, connected with the Stevens Institute of Technology.

Int. 3. How long have you been engaged in that institute?

A. Seven years.

Int. 4. Have you during that time had your attention directed to the subject of electricity, and to what branches especially?

A. I have, especially to the branch of testing electrical apparatus; making and constructing various telephonic apparatus, and the solution of various electrical problems.

Int. 5. Have you made yourself familiar with the practical working of telephone instruments generally?

A. I have.

Int. 6. Have you, at the request of the counsel for the defendants in these cases, been engaged for some time past and for how long, in practical tests of the operation of certain forms of telephonic apparatus?

A. I have been so engaged for a period of three or four months.

Int. 7. Where mainly have those experiments been conducted?

A. They have been conducted at my laboratory, at my house in East Orange, New Jersey.

Int. 8. By whom have you been assisted?

A. By Mr. E. W. Smith.

Int. 9. You stated Mr. E. W. Smith; of Newark, New Jersey?

A. Yes, sir.

Int. 10. Is he a practical electrician, familiar by experience with the working of telephonic instruments?

A. I consider him to be so, judging from the work which we have done together during the past two or three months, and from the fact that I learned that he was the manager of the central office in Newark, New Jersey, operating the patents for the Bell Telephone Company and subsequently that he acted as superintendent of the Overland Company at Newark, New Jersey.

Int. 11. Will you state in detail the nature and results of the experiments in which you have been engaged, and if you have such a statement prepared in writing you can present it?

A. I have prepared a statement of the experiments which I now hand to the examiner.

The following is a copy of the statement:

"The experiments were begun in April and carried on at intervals until the middle of July, 1885.

"They were conducted at my house in the township of East Orange, New Jersey. The circuit was about three hundred and fifty feet in length and extended from the house to the stables and return. The instruments were placed part of the time at the ends of the line,—in the house and stables, and part of the time in distant parts of the house separated by two closed doors. The battery used was from one to five Leclanche cells. The first experiments were with two Baxter transmitters; one of them was used as a transmitter while the other was used as a receiver; the induction coils were not used, and both instruments were in the battery circuit. The ear was simply applied to the mouth opening in the instrument used as a receiver and in this way many words and short sentences were transmitted and correctly received—such as the names of States: Maine, Louisiana, California, etc., also various railroads and ex-

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press companies, such as The Pennsylvania Railroad, Delaware, Lackawanna and Western Railroad, Adams Express Company, etc., etc.

"The next experiments were made with instruments constructed by Mr. E. W. Smith as follows:

"A square box of wood was made, provided with two binding posts and having a hole in the front for a mouth piece. On the cover of this box a circular hole about two inches in diameter was bored and a piece of skin tightly stretched over it; a piece of platinum was glued to the centre of this skin and connected by a wire to one of the binding posts. Two little screws were placed at the margin of the circular hole, one terminated by a little pit on which a drop of quicksilver was put; the other pointed. An angular piece of metal was used as a hammer—having two feet, one of platinum which rested upon the piece of platinum glued to the centre of the membrane or skin, and the other rested in the little cavity containing the quicksilver. The opposite arm of the hammer had a small hole bored near the end of said arm and rested upon the pointed screw. The entire hammer piece in this instrument weighed twenty grains. From the pin or screw containing the quicksilver, a wire extended to the second binding post. A block having a hole about three inches in diameter was placed over this cover, thus forming an outer circle.

"This instrument is hereafter referred to as No. 1.

"Another instrument constructed precisely like No. 1, except that the box was dispensed with in order to apply it to the ear, was used as a receiver and is referred to as No. 2. The hammer piece in this instrument weighed nineteen and a half grains. A third instrument of the same kind as No. 2 was made and used as a receiver, in which one of the platinum pieces was replaced by a piece of carbon. This instrument is referred to as No. 3. The hammer piece in this instrument weighed twenty-nine grains.

"With the above named instruments many experiments were tried, much time was consumed in obtaining the requisite bearings of the points of support of the hammer

piece, so that it could move with perfect freedom; this could only be done by repeated trials in which the hammer piece was slightly moved or jarred each time, and also in rendering the weight of the hammer—neither too great or too small, which was done by making the platinum foot quite long and then grinding it down until it worked freely and speech was transmitted by or through it. It was not until after this that they were weighed and the weights found to be twenty grains, nineteen and a half grains and twenty-nine grains for Nos. 1, 2 and 3 respectively.

"Whenever the above conditions were obtained, together with the requisite tension of the membrane or skin—articulate speech was always transmitted and received by the above instruments clearly and distinctly; but as will be seen from the nature of some of these conditions, they were not always at the control of the operator, such as for instance the tension of the membrane which depended largely upon the state of the atmosphere at the time, or the balancing of the hammer piece on its supports, which could be obtained only by careful trials.

"When in working order—with instrument No. 1 as a transmitter, and a receiver known as the Lockwood-receiver of magneto class, long and sustained conversation was carried on. Among other things the following paragraphs from the New York Times were read by me while sitting in a chair in front of instrument No. 1, and two or three feet distant from the mouth opening, and correctly received by Mr. Smith at the other end.

"'Pennsylvania Railroad, Great Trunk Line and United States Mail Route.

"'Trains leave New York via Desbrosses and Courtlandt Street Ferries, as follows:

"'Harrisburg, Pittsburg, and the West, with Pullman palace cars attached, 9 A. M., 6, 7 and 8 P. M. daily. New York and Chicago limited, of parlor, dining, smoking and sleeping cars at 9 A. M. every day.

"'Among the passengers of the Inman Steamship City of Chicago, which sailed yesterday for Liverpool, were Pres-

dent , of San Salvador; the Hon. George C. Tanner, United States Consul at Liege; the Rev. Dr. J. C. White, the Rev. Dr. S. H. Howe, the Very Rev. Henry Gabriell.'

"With instrument No. 1 as a transmitter, and instrument No. 3 (one carbon point) as a receiver, the following was spoken by Mr. Smith and received perfectly by me:

"'What is the distance from San Francisco to Chicago?

"'What railroad ought I to take going from San Francisco to Omaha? This has been a fine day, hasn't it?'

"Changing places I went to the transmitter, and Mr. Smith to the receiver, when the following was spoken and received perfectly: 'Hollo. Mr. Smith! Have you read the morning papers? The morning papers say that Gen. Grant has begun work on his new book?'

"Several weeks after this, instrument No. 2 was connected with instrument No. 1, (both instruments have platinum-electrodes). Mr. Smith was not present at this time. I speaking and Mrs. Paddock at the receiver. The following was transmitted three times and received correctly each time.

"'Do you think it will clear off so that we can take a drive in the park?'

"I then went to the receiver, and Mrs. C. A. Paddock spoke into the transmitter, when the following was received with perfect distinctness:

"'Mr. Robinson and I went over to the West side in Chicago to hear Dr. Hatfield; when we got there the church was crowded. The church resembled the Broadway Tabernacle in New York.' Much more was transmitted by all these instruments at various times of which no record was preserved.

"After these experiments were completed, I continued the work by experiments with the Reis instruments. They were the cubical box transmitter and the knitting needle receiver. These experiments were made on the 15th, 16th and 17th of July, 1885, at my laboratory in East Orange. The instruments used were substantially the same as those

figured in Defendants' Exhibits, pp. 673, 674, Molecular Telephone case, and herewith appended; they were obtained from President Morton of the Stevens Institute of Technology, and were said by him to be Exhibits in the Spencer case.

"The transmitter was used in a variety of ways and good articulate speech was obtained in each of these ways, viz.: the box was placed in both of the positions figured in the annexed photographs, it was also placed horizontally and the lid closed. It was sometimes spoken to with the mouth close to the mouth piece, at other times standing over it and speaking down on to the diaphragm and at other times with the lid raised as in the photograph No. 2 and sitting two or three feet away from it.

"The best results were generally obtained when standing over it and speaking down on to the diaphragm in a moderate and sustained tone of voice and without explosive utterance such as would be given for sake of emphasis.

"As in the case of the previous experiments with instruments constructed by Mr. E. W. Smith, it was found necessary that the hammer piece should have as nearly as possible a free motion upon its supports, and this could only be obtained by repeated trials, viz.: lifting it up and letting it fall on its supports, moving it a hair's breadth one side or the other, or jarring it slightly, so as to change the points upon which it rested. It was observed after many trials that when in a position best adapted to transmit speech, the little platinum foot which was the electrode of the hammer piece, would rebound several times or chatter on the platinum strip glued to the membrane and forming the other electrode, whenever lifted, no matter how slightly and let fall again, which would seem to indicate a very light contact and well balanced supports to the hammer piece.

"The following is a record of the sentences transmitted and received with these instruments:

"'Hollo. Mr. Smith? How do you hear me? Did you get that? Is that any better? When does your train go?

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"'Hollo. Mr. Paddock? When will I have to leave for home? How far is it from Brick Church to Newark?

"'Hollo. Mr. Paddock?

"New York, July 16th, 1885.

"'My Dear Sir:—Will you kindly call at my office to-morrow, at ten o'clock.

'Yours respectfully,

'JOHN J. HOPKINS.'

"'Hollo. Mr. Smith. Hollo. How long can you stay to-day; can you remain until eight o'clock?

"'Hollo. Mr. Paddock. Hollo. Hollo. I can remain until eight o'clock if necessary. I would like to take the 5:37 train.

"'Hollo. Mr. Smith. Where are you going this summer for a vacation; have you ever been to the Adirondacks? Have you ever been to Blue Mountain Lake? You can take the boat at New York and go to Troy, and then by railroad to Whitehall, and from Whitehall by steamer through Lake Champlain. Hello. Did you get all that?'

"Mr. Smith came to the transmitting room after this and said he received every word of it and repeated it to me.

"We also made experiments with the Baxter transmitter and a Reis receiver, knitting needle form.

"With these instruments, conversation was carried on at great length. The following are examples:

"'Hollo. Mr. Paddock? I hold in my hands Prescott's book, 'The Speaking Telephone, Electric Light and other recent inventions.' Do you think it is a good and reliable work? I do, and I hope that you agree with me. Have you read Gordon's work on electricity and magnetism, and do you consider it a good work?

"'Hollo. Hollo. Mr. Smith. What do you think about introducing industrial training into our schools? What do you think about using carpenters' tools in these schools, such as planes, saws and chisels?

"'Have you noticed that we have our warmest weather now in September? I have noticed of late years that we

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have a few warm days in July and August, but our warmest weather often comes after the middle of September.'

"The Reis knitting needle receiver requires a fresh strong battery of from five to six cells, to be effective."

Int. 12. Have you here present the instruments with which you made these experiments?

A. I have them here present.

Int. 13. Will you produce instrument number one, to be marked as an exhibit?

A. This is it (producing instrument.)

Said instrument is offered in evidence and marked No. 1, Paddock, September 19th, 1885.

C. N. WILLIAMS, Special Examiner.

Int. 14. What is this?

A. That is number two.

Said instrument is produced and marked No. 2, Paddock, September 19th, 1885.

C. N. WILLIAMS, Special Examiner.

Int. 15. What is this?

A. Number three.

Said instrument is produced and marked No. 3, Paddock, September 19th, 1885.

C. N. WILLIAMS, Special Examiner.

Int. 16. What are the other instruments?

A. These are the instruments which Professor Morton handed me.

Int. 17. Will you produce the instruments which you refer to as those given to you by Professor Morton?

A. I will do so.

These instruments are produced and marked No. 4, Paddock, September 19th, 1885, and No. 5, Paddock, September 19th, 1885.

C. N. WILLIAMS, Special Examiner.

Int. 18. Have you the photographs to which you refer in your examination?

A. I have these photographs with me.

Int. 19. Will you produce them and have them marked,

or refer to the pages in the Molecular case where they can be found?

A. They can be found in defendant's exhibits, Molecular telephone case, pages 673 and 674.

Int. 20. Have you recently made experiments with the Reis transmitter and receiver marked as an exhibit in Frankfort, Germany, in the testimony of Dr. Stine, and referred to in the testimony of Professor Thompson?

A. I have, within the last two days.

Int. 21. Are those instruments now in your possession and before the examiner?

A. They are now in my possession and before the examiner. The transmitter is marked "Defendant's Exhibit, Reis—Frankfort Instrument, July 16th, 1884, S. D. O., Com., in two parts, 137 a and 137 b."

Counsel for the complainant objects to the introduction of these instruments as having been brought from and made in Europe and, therefore, not competent evidence to anticipate a patent in the United States, it being entirely immaterial in law whether Bell's invention, pure and simple, had been made and practiced for a hundred years in Europe if it had not been patented and published there.

Int. 22. Do you find these transmitters and this receiver described and drawn in a printed publication concerning the Reis instruments?

A. I find this transmitter figured and described in the Reis publications entitled "Defendant's Exhibit, Reis Lecture, Yearly Report of the Physical Society at Frankfort on the Main, 1860 to 1861," on page 24 of Defendant's Exhibits, in the American Bell Telephone Company vs. The Molecular Telephone Company.

Int. 23. What difference, if any, do you find between this transmitter and the drawing contained in that lecture?

A. The difference I find is, that this instrument is provided with an adjusting screw of peculiar device which is not figured in the drawing of the Reis lecture.

Int. 24. On what part of the instrument is that adjusting screw?

A. This adjusting screw passes through the strip of brass which terminates in one of the electrodes, and is screwed into the wooden block. There is no other cut in the brass strip so that the screw proper does not appear to adjust that strip; but the screw is supplied with a spiral cord wound around it so that when this coil is operative it presses down upon the brass strip to follow the vibration of the diaphragm when it is retreating.

Int. 25. What is the condition of the spiral cord on that instrument?

A. I find this coil to be practically useless, having lost its elasticity, apparently from age. It is inoperative.

Int. 26. Is the instrument now exhibited in the same condition as when you received it from Mr. Keasbey?

A. The instrument is in the same condition as I received it.

Int. 27. Have you made any alterations in it whatever except to remove the screw and adjust the wires?

A. I have made no alteration except during the experiments. I dispensed with the adjusting screw entirely and used only the means furnished by the strip itself and the binding screw for adjustment.

Int. 28. Is the membrane the same as when you received it?

A. The membrane is the same.

Int. 29. Who assisted you in your experiments with this instrument within the last two days?

A. Mr. E. W. Smith, of Newark.

Int. 30. Where?

A. At my laboratory at my house at East Orange, New Jersey.

Int. 31. On what line?

A. On the same line that was used in the previous experiments.

Int. 32. Where was the transmitter placed?

A. The transmitter was placed in my laboratory in the house.

Int. 33. Where was the receiver placed?

A. The receiver was placed in the stables at the rear of the yard.

Int. 34. Will you now look at the receiver and state how it compares with the receiver shown on page 98 of the defendant's exhibits in the Molecular case?

A. It is substantially the same; except in the one figured on page 98 there is a signaling apparatus on the side, and in the exhibit the signaling apparatus is on the inside and of different shape.

Int. 35. Have you that receiver in your hands?

A. I have.

Int. 36. It is in the same condition it was when you received it?

A. It is in the same condition, except when I received it the resonance box was much broken and smashed and one of the wooden supports of the needle was gone. I glued it together as best I could and made a wooden support—this one—and corresponding to that one.

Int. 37. Is there any new part then except simply the single wooden support?

A. There is no new part which I added except that support. I merely glued it together.

Int. 38. Will you now state the results of your experiments made with that transmitter and receiver?

A. I will read from a record which I made during the experiments, the nature and the result of them. With this instrument I transmitted and received with Mr. Smith a few songs, some with and some without the words of the songs. Sentences were also transmitted of which I received single words; other sentences in which two or three consecutive words were received, and finally I succeeded with Mr. Smith in transmitting short sentences in which the whole sentence was received. This is the record: Transmitted by Mr. Smith, Hollo! Paddock. How do you hear me? Received by me, Hollo! Paddock;

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transmitted by me, Hollo! Mr. Smith, how is that? How is it now? Is that any better? Received by Mr. Smith, Smith, better; transmitted by Mr. Smith, Hollo! Mr. Paddock, Hollo! Hollo! Do you hear what I say? New York and Philadelphia. Received by me, Hollo! Mr. Paddock; New York and Philadelphia; transmitted by me, Hollo! Hollo! Mr. Smith, can you hear me? Did you go down to see the yacht race yesterday? Received by Mr. Smith, Hollo! Mr. Smith, can you hear me? Did you go down? Transmitted by Mr. Smith, Delaware and Lackawanna and Western Railroad Company.

Song sung by Mr. Smith, "Down on the Swanee River."

Song sung by Mr. Smith, "Home, Sweet Home."

Received by me, Delaware, Lackawana and Western Railroad Company. Both songs were received. Transmitted by me. Did you get the letter I sent to 203 Broad street, Newark, New Jersey? Received by Mr. Smith. Did you get the letter (blank) 206 Broad street (blank.) Transmitted by me. Hollo! Mr. Smith, did Mr. Keasbey get my telegram which I sent this morning. Song sung, "Battle Cry of Freedom." Received by Mr. Smith. Hollo, Mr. Smith, Mr. Keasbey get my telegram (blank) I sent this morning, Song received.

Int. 39. How did you verify the fact that these songs were received in these experiments?

A. We had a single line circuit, and one of us being at the transmitting instrument and the other at the receiver, and when he received, came back to the transmitting room and repeated what he had received, and the person who transmitted it verified what he had received from what he had transmitted.

Int. 40. Did you do that in the case of these sentences which you have proved, with care, so that you could be certain of the actual transmission of the words given?

A. We did; with great care. The person who received these words would leave out in blank spaces what he could not positively say he heard, and give the words which he positively knew that he heard.

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Int. 41. Are you certain, as a practical man, that these results are actual results of transmission of articulate speech under the circumstances you have mentioned, and not to be ascribed to the imagination. Are you certain of the validity of the experiments?

A. I am certain of the validity of the experiments, but I would say that with familiar sentences, such as Hollo, How do you get that; Hollo! Mr. Smith, that the imagination goes a great ways in receiving such words; but with regard to the other words, they were unexpected and, therefore, I thought the imagination could not have aided in receiving them.

Int. 42. Did Mrs. Paddock assist during some of the time when you were away?

A. She did, as appears in this report which I have given.

Int. 43. You know the fact that while you were absent part of the time she assisted Mr. Smith in the experiments?

A. She did. I was obliged to go to the Stevens Institute and Mrs. Paddock assisted Mr. Smith.

Counsel for complainant renews the request which he has heretofore made in respect to the experiments with what are called Reis instruments, that they be repeated in the presence of witnesses, as in the Dolbear case, in order that the conditions under which they are made may be verified, and that it may be ascertained whether the words supposed to be heard were, in fact, spoken.

Counsel for defendants asks whether counsel for complainant is willing to extend the time for closing these proofs sufficiently to enable him to have such experiments made.

Counsel for complainant says that it is their purpose to bring this case to a hearing in the October term. That the defendants, not having closed their testimony, the complainant has not been able to put in his reply, and that he believes there will be no time to extend the defendants' testimony; but he

says that during the time of taking the testimony in reply for the complainants he would be very glad to have the defendants produce to the experts of the complainants and their experts, the apparatus which they say is a reproduction of the Reis apparatus, and to have the defendants, or their experts, try to hold up a conversation by the use of those instruments under conditions similar to those in which the similar trials were made in the Drawbaugh case and the Dolbear case.

Cross-exanined by Mr. Dickerson.

X. Int. 44. As I look at this bored block transmitter marked Reis-Frankfort Instrument, I observe that the brass strip carrying the platinum contact point is constructed so as to be adjusted to press upon the platinum patch on the diaphragm. As at present, when the screw with the spiral spring is withdrawn, it presses with very considerable force on that platinum point and that pressure can be controlled by reason of the peculiar construction of the brass strip itself. Now, will you inform the Court whether, when you tried your experiments, you did not have it so adjusted as that the contact between the platinum point and the platinum strip was maintained when you were speaking into the cone?

A. The platinum strip was so adjusted that we could get sounds through it and get speech. Whether it was adjusted so that the contact was maintained during that time—the whole of that time—I don't know.

X. Int. 45. Then you didn't take the trouble to find out whether you adjusted your thing to work as a microphone or a circuit breaker?

A. I took this trouble and with this object in view, to so adjust it that speech would be heard at the other end, and my attention was not especially directed to whether the contacts were in connection all the time or not. I couldn't judge. I viewed them as closely as I could. I saw no spark, but entered into no scientific investigation.

X. Int. 46. If I understand you, you had five cells battery on that?

A. Yes, sir.

X. Int. 47. Isn't it as certain as anything in the world that if that circuit had been broken, there would have been a spark?

A. I think that if the circuit had been broken to a considerable extent, it is certain that there would have been a spark—with five cells.

X. Int. 48. That isn't the question. Isn't it as certain as anything on earth that if that circuit was broken at all so that the current ceased to flow, there would have been a spark?

A. I think that if the circuit—

X. Int. 49. Don't you know that there would as well as you know anything?

A. I know it—from theoretical consideratons, I know it.

X. Int. 50. Don't you also know that when the contacts are maintained by a suitably adjusted pressure, and a variation of that pressure is made by vibrating the diaphragm, the current passing through the joint will vary with the pressure in a ratio somewhat in proportion to the variation in the vibration and to the air waves that produce that vibration?

A. I do know that.

X. Int. 51. That is called a microphone, isn't it, in the language of science, to-day?

A. It is so used.

X. Int. 52. Will you just look on the drawing of this bored block transmitter in the Reis lecture as exhibited in the Molecular record, page 27, and say where there is any provision, such as in the actual block produced, for adjusting any pressure between the contacts?

A. The provision which I observe in this drawing is in the elasticity of the strip of brass which is here shown, and I observe that the terminal contact point is raised above the level of the base of the binding screw, this binding screw

by being screwed down tighter or loosened would vary the the pressure at the contact point.

X. Int. 53. Does not the binding screw press the base of that arm square down upon the block without any curve arrangement such as shown in your model for varying the pressure?

A. It does press the arm referred to down upon the block, apparently, in that figure.

X. Int. 54. And with that construction, the point being set at a definite distance from the diaphragm; when the diaphragm vibrated it would leave the point of reflexion and touch on condensation of the air?

A. As I understand the interrogatory, if the arm is so fixed that the contact point is at some distance from the the platinum strip, it would so operate.

X. Int. 55. And isn't that the operation specifically described in the text in these words: "At the first condensation the hammer-like wire d. is pushed back; at the rarefaction it cannot follow the retreating membrane and the current traversing the strip remains broken, until the membrane forced by a new condensation again presses the strip against d. In this way each sound wave causes a breaking and closing of the current?"

A. It could be so described.

X. Int. 56. Isn't that a true description?

A. It would be a true description. I think the description would also apply provided it was not held at a fixed distance; that same operation would be described in those words.

X. Int. 57. That is to say you think that if the apparatus was constructed so that the arm carrying the platinum strip was put under a tension and made to follow the platinum patch on the diaphragm, that the operation would be a compliance with the description in the books?

A. I do not so understand it. It would follow the diaphragm, but I understand it to be a description in which the arm at some point of its following the membrane, parts from it.

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Q. And don't you know that that is the very distinction between a circuit breaking transmitter and a microphone transmitter?

A. I do not fully understand what a circuit breaking transmitter is meant to be.

Q. Well, I will try to make it plainer. Isn't that the very distinction between two transmitters, one of which makes and breaks the current at each vibration and the other of which does not break the current at all, but maintains its constant contact.

A. It is.

Re-direct by Mr. Keasbey:

R. D. Int. 1. I find on page 243 of complainants' proofs in the case of the American Bell Telephone Company against the Baxter Telephone Company, this statement by Professor Cross: "It is of no importance whether the characteristic similarity in form between the air waves and electrical waves is produced by the variations in electro-motive force due to a magneto transmitter; to the variation in resistance caused by a microphone or other battery transmitter; or, if such a thing were possible, by a series of excessively minute breaks produced by a circuit breaking transmitter. If by any form of transmitting telephone these characteristic variations in form, to which the quality of a sound is due, are impressed upon an electrical current so that the electrical undulations are similar in form, to the sound waves which act upon the transmitter, the method employed is that invented by Mr. Bell, as distinct from the method used by Reis." Can you assert as a definite fact, scientifically, that in your experiments with the Reis-Frankfort Instrument while transmitting speech, there were or were not exceedingly minute breaks produced by that instrument?

A. I could not so state whether there were minute breaks produced or not. I know of no means to ascertain such minute breaks.

Asahel K. Eaton, produced and sworn on behalf of the defendants in the above cases, testified as follows:

Direct examination by Mr. Keasbey:

Int. 1. Where do you live?

A. In Brooklyn.

Int. 2. What is your profession?

A. I am a practical chemist and manufacturer of electrical instruments.

Int. 3. How long have you been engaged in that work?

A. About twenty-five or thirty years.

Int. 4. Where is your laboratory?

A. At 65 Henry street.

Int. 5. Before 1875 were you engaged in lecturing on chemistry and physics?

A. I was for many years.

Int. 6. Did you know prior to that time in the course of your lectures, of the publications concerning Reis' telephone, or any of them?

A. I did; some of them.

Int. 7. Which one were you, prior to that time, familiar with?

A. The first notice I saw of the Reis telephone was in the Journal of Science I think, about 1862. I don't remember the exact date; and the only thing after that for some years was the account in Ferguson on electricity.

Int. 8. Did you have a copy of Ferguson's description?

A. Yes, sir.

Int. 9. Did you make any experiments with the Reis instruments in the winter of 1875?

A. I did, earlier than the winter.

Int. 10. What time in the year?

A. In the summer and fall of 1875.

Int. 11. Had you at that time heard of any work in that direction by Professor Bell?

A. I had not.

Int. 12. What experiments did you make with the Reis instruments?

Counsel for complainants objects to the testimony of this witness, who has not been set out in the answers heretofore as having former knowledge of the Bell invention, if it is the object of the defendants to prove by him that he had a talking telephone in Brooklyn in 1875.

A. I made a rude copy of the Reis telephone with such materials as I had at hand;—making use of a parabolical reflector which had been used as a head light. I covered the front main opening with a thin board partition —a board covering the front and about three-eighths of an inch in thickness—I think the first one. I then made use of the cross bar for supporting the contact point which was fastened to the mouth of the reflector, and used the ordinary platinum connections as described in the Reis instrument, except I did not make use of the ordinary rolled platinum but used the welded platinum, which I welded myself, simply because that was really what Reis must have used, and I thought it worked a good deal better; that is, I welded platinum sponge instead. That was the only distinction so far as the principle is concerned.

Int. 13. What did you use for a receiver?

A. I used—in that case I took a resonance box that I had used for an Æolian harp, from which an arm was screwed and an electro-magnet fixed beneath it. The electro-magnet was fixed solidly to the table.

Int. 14. Have you in your hand a drawing showing the manner in which that transmitter and receiver were set up?

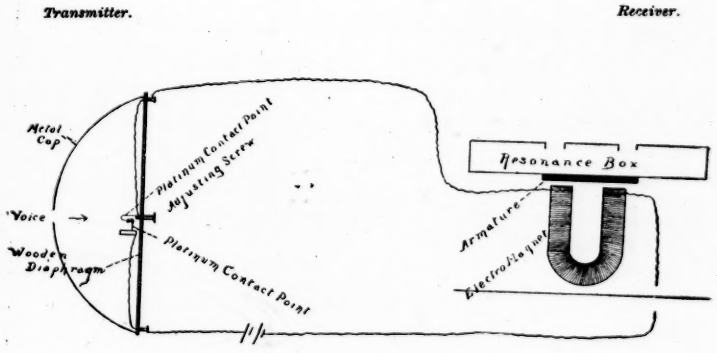
A. I have.

Int. 15. Does that drawing correctly show the instrument that you have been speaking of?

A. Yes, sir; this represents a second form. I first used a contact point touching on the outside of the diaphragm, and afterwards I cut a hole in the centre of the diaphragm, and made my point make a contact on the inside instead of the outside.

This figure is offered in evidence and marked Eaton No. 1, September 19, 1885.

C. N. WILLIAMS,
Special Examiner.



Int. 16. What results did you obtain from that instrument?

A. With that instrument I was able to reproduce musical sounds without any trouble, and in some cases indistinct articulation of a few words or very short sentences.

Int. 17. Can you give the date of these experiments, certainly?

A. I can only say that it was in the summer or fall of 1875.

Int. 18. Are you quite sure that it was before the winter of 1875? During the summer and fall of that year?

A. Yes, sir; I can speak positively in regard to that.

Int. 19. What means have you of knowing the time when these experiments were made?

A. My assistant who assisted me in these experiments is

now in New York in connection with the World, and I consulted with him so as to be absolutely certain about it. He came to assist me in January, 1875.

Int. 20. Did you also made experiments with the cubical box form of the Reis transmitter?

A. Yes, sir; I made one soon after that.

Int. 21. How long after that?

A. It was within the same year; I probably could get at the exact date because the man that made the box is living; I can ascertain probably.

Int. 22. From what drawing or information did you make the transmitting instrument?

A. That one was wholly from the drawing in Ferguson.

Int. 23. Did you make it accurately according to that drawing and description?

A. Yes, sir.

Int. 24. What receiver did you use in connection with that instrument?

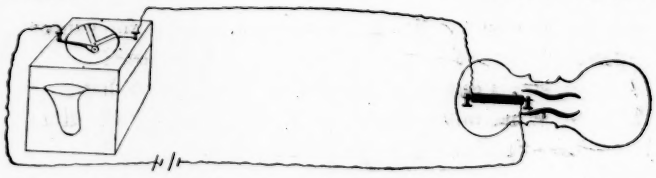
A. I used an old violin. On top of it I mounted also a knitting needle and coil in that way.

Int. 25. Does the drawing now shown exhibit truly the transmitting and receiving instrument that you have just mentioned?

A. It does; yes, sir.

This figure is offered in evidence and is marked Exhibit Eaton No. 2, Sept. 19th, 1885.

C. N. WILLIAMS,
Special Examiner.



Int. 26. What results did you get from this instrument?

A. Well, from that knitting needle receiver I got very feeble results; but evidence of articulation as though some one was talking at an immense distance. We could hear the modulations of the voice but couldn't tell what they were saying. Those were my first results. I afterwards got better results.

Int. 27. Did you use a Reis transmitter with a condenser receiver like that used by Wright in Ferguson's report?

A. Yes, sir; I did.

Int. 28. What results did you get from that?

A. With a strong induction coil I got very distinct articulation of some words and parts of words. When I perfected the transmitter why, I got it very distinctly afterwards.

Int. 29. Were you one of the parties in what is known as the Spencer suit?

A. I was not.

Int. 30. Or in one of the cases which was tried with the Spencer case?

A. Yes, sir.

Int. 31. Were you sworn as a witness in that case?

A. I was not.

Int. 32. Were you called upon to give any account of the experiments that you had been making with the Reis instruments in that case?

A. I was not.

Int. 33. Have you in your possession any parts of this instrument shown upon this figure?

A. Yes, sir; I have all these at my place, and I have those that are called for.

Int. 34. Just take those two drawings, and say which of those identical instruments used in 1875, or what parts of them you still have in your laboratory?

A. I have all these parts, except the platinum of No 1. transmitter is not on, and the electro-magnet has been used for other purposes.

Int. 35. Have you the violin receiver and the cubical box transmitter still in your possession?

A. Yes, sir.

Int. 36. Did you after that time and after the decision of the Spencer case, make further experiments with the Reis instruments?

A. I did.

Int 37. And with what result?

A. Well, I got finally very good results.

Int. 38. What sort of instrument did you experiment with afterwards from which you got good results?

A. I manufactured one of his electro-magnetic receivers. I used an electro-magnet for actuating an armature upon a resounding box, and with that I got—after various experiments, got good results.

Int. 39. What do you mean by good results? Did you actually transmit articulate speech in continuous sentences?

A. Yes, sir; I did. I got from that form of Reis' receiver full sentences; very distinctly but not very loud, but very distinctly.

Int. 40. About what time were these latter experiments made; or through what time?

A. I can ascertain those dates exactly—I think about 1881.

Int. 41. Did you in 1881 obtain a patent for an improvement on the knitting needle receiver of Reis?

A. I cannot give the date of the patent. I did that before 1881.

Int. 42. What was the nature of the improvement?

Objected to, because the patent itself is the only proper evidence.

A. I arranged in an ordinary hand telephone case a diaphragm of brass or any non-magnetic substance that was attached to the core passing through the coil of the knitting needle receiver. In the first form I simply used a straight wire of iron or steel, or varied the experiment. Afterwards I used a bundle of iron wire, and finally I used a spiral head by binding steel or iron wire closely so as to take the place of a solid rod.

Int. 43. Before 1876 had you had in your possession, or had opportunity to examine any of the Reis publications except the Ferguson?

A. No, sir.

Int. 44. Had you then seen the Reis-Legat article, or the Reis lecture?

A. No, sir.

Cross-examined by Mr. Dickerson:

X. Int. 45. Are you the gentleman who organized the company known as the Eaton company?

A. It was organized under my name; yes, sir.

X. Int. 46. (Question repeated, which was:—Are you the gentleman who organized the company known as the Eaton company?)

A. Well, I was not strictly the one that organized it; I was the principal.

X. Int. 47. Principle stockholder?

A. No, I wasn't the principal stockholder. There was a company organized upon my patents.

X. Int. 48. And those patents were for a transmitter which was the subject of suit of the American Bell Telephone Company against Spencer in Boston?

A. I believe so; yes, sir.

X. Int. 49. And also against your own company in New York?

A. Yes, sir; we defended the suit.

X. Int. 50. You defended the Boston suit—the Spencer suit?

A. Yes, sir.

X. Int. 51. I notice in your answer in your Boston suit that you set yourself up by name as a person having prior knowledge of the Bell invention long before his patent. I will quote your answer, with the view that Mr. Keasbey's criticism may be overruled. You say, "the defendant avers that long prior to any invention thereof by him (meaning Bell) the same was known to, and used by the following persons at the following places, to wit:" You then give

the names of a number of persons, yourself among the rest. Did you authorize that statement to be made and sworn to by the nominal defendant?

A. It is a thing I personally could not swear to, because I don't know anything about what these other men swore to.

X. Int. 52. Did you authorize that answer to be made and sworn to in respect to yourself?

A. I presume I did if my name is to it, but I want to read the article first, because I want to know what it is. All I have to say with regard to myself that that is true so far as I knew it before any invention of Mr. Bell's. I don't know when he invented it. I am sure I don't claim it as my invention. I only claim what I claim as an improvement upon Reis. I never claimed anything else. I never stated the thing in that language at all verbally before, but I don't know with regard to these persons.

X. Int. 53. You were yourself a defendant in the New York case personally?

A. I don't know; I never had anything to do with only one case that I am aware of.

X. Int. 54. Then you haven't any knowledge have you, that there was a suit against your company and you, personally, in New York, as well as a suit against Spencer in Boston?

A. There might have been, but I could never come to the trial; I was sick at the trial; I was confined to my room.

X Int. 55. Having that answer on file you didn't offer yourself as a witness to prove its truth, so far as you were concerned?

A. I have just stated, I could not have gone because I was confined to my room by sickness sometime previous and during the time of the trial, but I would have been very willing to have gone.

X. Int. 56. Then you mean to say to the Court that you intended to be a witness to verify the truth of your answer, but that you were so sick that you couldn't be a witness?

A. I would say sick; but that was not the reason why I was not a witness.

X. Int. 57. After that answer was put in, were you in a condition in which you could have been examined as a witness before the testimony was closed?

A. I don't remember; I was always ready when called upon, and very willing.

X. Int. 58. Can you tell us when it was you were sick, and how long you were so sick that you couldn't be examined as a witness?

A. I could get at it, but I couldn't tell you now.

X. Int. 59. Can you remember whether it was a year or two years that you couldn't be examined as a witness?

A. There was plenty of time to examine me as a witness, but I spoke of the trial—at the time the trial came off.

X. Int. 60. Give the other reason why you could not be examined as a witness, if sickness was not the only one?

A. As I understand, the reason that I always insisted that my invention was an improvement of the Reis. They didn't wish to threw it open to the public.

X. Int. 61. Then, if I understand your statement, it was determined by you and your counsel not to examine you as a witness because by so doing the Reis invention with your improvement upon it would be opened to the public?

A. That is what they seemed to think. Some of them at least.

X. Int. 62. Your invention was made in 1875 as you now stated?

A. No, sir; I never gave that time.

X. Int. 63. Then your experiments were made in 1875?

A. My experiments with the Reis transmitter and receiver were made in 1875.

X. Int. 64. Then it was in respect to those experiments made in 1875 that you and your counsel decided not to examine you for fear that the public would get the invention?

A. No, it was on account of the experiments that I tried

afterwards showing that the Reis telephone could be made to produce articulate speech.

X. Int. 65. Then it was determined between you and your counsel that you would not prove what you knew to be true, that Reis would give articulate speech because you were afraid it would open it to the public?

A. I don't know the way of lawyers. I understood it was the reason why they did not wish to use my evidence.

X. Int. 66. They didn't wish to prove that Reis' was an articulating telephone? Of course, you knew that Professor Morton was examined as a witness to prove that it could talk?

A. Yes, sir; I didn't know anything about it. Mr. Morton was brought into the very close of the thing when they were driven into a corner. They did expect to take some movement in that direction. I had always taken the ground that it must be fought on the ground as an improvement of the Reis telephone. That was the correct ground.

X. Int. 67. When were these experiments tried which you and your counsel considered advisable not to testify about? Will you state that?

A. All my experiments were tried at 65 Henry Street.

X. Int. 68. When? I asked you when the experiments were made?

A. I never consulted myself with my counsel about it—only with the other proprietors of the company; I had a talk with them about it.

X. Int. 69. Where do you suppose your counsel got the information that they claimed to have unless you gave it to him?

A. They got it through my partners?

X. Int. 70. And you told your partners and they told the lawyers?

A. I presume so.

X. Int. 71. But you told your partners that fact?

A. I always took that ground.

X. Int. 72. Now, I come back to the other question, when

was it that you made those experiments which showed that the Reis instrument was a good articulating telephone, and which experiments you concluded it was not advisable to testify about for reasons which you have already given?

A. Well, all the way from the time I began these experiments until I gave them up—for probably two years more or less at different times; and I always took the ground from the time I first got articulation, or any articulation, that it was capable of being made to articulate distinctly. Now, I did not carry out these experiments in full except so far as to satisfy myself, and to satisfy my own partners that it could be done, and that is the day when they refused to take that ground they started the interference suit. I then made for other parties outside; I made them Reis telephones that would transmit and receive articulate speech very satisfactorily.

X. Int. 73. Then it was not those experiments made after the trial that you refer to, but some experiments that you made before the trial?

A. Certainly.

X. Int. 74. And you decided that it was not expedient to testify about those experiments because you didn't wish to give it to the public?

A. I did; I always took the ground that it should be opened to the public.

X. Int. 75. Why didn't you then testify in order that it might be opened to the public?

A. Because they didn't call me.

X. Int. 76. Who did you make those experiments of the Reis telephone for?

A. There were some parties—a Mr. Glen and a Mr. Lincoln of Hartford.

X. Int. 77. Who else?

A. Nobody except my company. Of course, I felt interested in the results myself. I did it at their expense and at their solicitation.

X. Int. 78. Were they connected with any telephone company or were they connected with any defendants, or

afterwards showing that the Reis telephone could be made to produce articulate speech.

X. Int. 65. Then it was determined between you and your counsel that you would not prove what you knew to be true, that Reis would give articulate speech because you were afraid it would open it to the public?

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X. Int. 77. Who else?

A. Nobody except my company. Of course, I felt interested in the results myself. I did it at their expense and at their solicitation.

X. Int. 78. Were they connected with any telephone company or were they connected with any defendants, or

themselves defendants in any telephone suits so far as you know?

A. I don't know; I had an impression that they were, or expected to be.

X. Int. 79. You were never called upon in consequence of those experiments you made for those people?

A. No, sir.

Re-direct examination:

R. D. Int. 80. Were you the chief stockholder in the company which defended the Spencer case?

A. I was not the chief stockholder.

R. D. Int. 81. Had you control over the operations and resolutions of that company?

A. I had not.

R. D. Int. 82. Did you have any negotiations or give any directions to counsel concerned in the suit as to the manner in which it should be conducted?

A. I did not—except voluntarily. I mean, except voluntarily I was not called upon by them to give any evidence. I gave a great deal of pains to get information—get translations from Italians and Germans, and I got hold of for instance, Popendorf's article, and of some articles published in Italian, and had them all copied and sent them to the lawyers, hoping that they—expecting in the first place that they would take this same ground of it being an improvement simply upon previously existing inventions. They paid no attention to it, and my partners all discouraged the idea of putting it upon the ground that these were improvements upon previously existing inventions. Therefore I was never called upon in that suit.

R. D. Int. 83. Did you communicate to your partners, or to those controlling the company, the nature of the experiments you had made with the Reis instruments and the results?

A. Yes, sir.

R. D. Int. 84. Were you always ready to be examined as a witness?

A. I always was. When I was able, of course.

R. D. Int. 85. Were you ever requested to be examined as a witness to prove these experiments?

A. I was not.

Re-cross by Mr. Dickerson:

R. X. Int. 86. When the Eaton Telephone Company was organized, what was the amount of its capital stock?

A. Five hundred thousand, I believe.

R. X. Int. 87. For what was that capital stock issued, for money or for patents?

A. For patents.

R. X. Int. 88. You were the owner of the patents, were you not?

A. Yes, sir.

R. X. Int. 89. Then you got the entire capital stock for your patents?

A. I did as a matter of form; yes, sir. That is the way those things generally are organized.

R. X. Int. 90. As a matter of substance, you put in the whole capital stock of the company?

A. There had been a great deal of money paid out in the patents, although as a matter of form the stock came to me and went back to the parties who had furnished the money previously for the work.

R. X. Int. 91. The money for the work in getting up those patents?

A. Yes, sir.

R. X. Int. 92. Who were the capital stockholders of that company when you distributed this capital after having received it in your own name, and in what proportions were these other gentlemen the holders?

A. There were only three principle stockholders—Mr. Tompkins, Mr. Cocksher and myself.

R. X. Int. 93. What were the proportions of you three?

A. I can't tell what proportion the others had. I had in the first place, one quarter.

R. X. Int. 94. Who was the president of the company?

A. C. T. Tompkins.

R. X. Int. 95. Who was treasurer?

A. George B. Cocksher.

R. X. Int. 96. Were you one of its directors?

A. Yes, sir.

R. X. Int. 97. Well, do you know who the lawyers were that you employed?

A. I don't know that I could name all of them. The only one I ever met, I think, was Mr. Wetmore.

R. X. Int. 98. Did you employ several?

A. I heard the names of several; I don't know how much they had to do with it.

R. X. Int. 99. Did you employ several?

A. I did not.

R. X. Int. 100. Did your company employ several?

A. Several were employed.

R. X. Int. 101. Were they employed by strangers or by the company?

A. They were employed by the president; generally he represented the company, and he was the manager of things so far as I know; did all that business.

R. X. Int. 102. Was he one of the first inventors of the telephone, or had he himself any knowledge of Bell's invention before Bell himself made it?

A. I can't tell; I don't know it, if he had.

R. X. Int. 103. You were the one on which the company was founded?

A. Yes, sir.

Re-direct examination:

R. D. Int. 104. In the answer of Albert Spencer on page ten of the Spencer record, which is the answer to which Mr. Dickerson called your attention, it is stated in paragraph five, that before any invention of Bell, the same (meaning the improvement and telephone) was known and used by a number of persons named in the answer, among whom your name is mentioned. Was that statement in that answer

true in point of fact, and did you use a telephone, namely, the Reis telephone, before the date of Bell's patent?

A. I did.

R. D. Int. 105. Did you use it before March 10th, 1876, in this country so as to produce articulate speech?

A. I did.

Further cross by Mr. Dickerson:

X. Int. 106. The answer was read to you as if the words "the same was known and used" meant the Reis telephone. I read you now the answer in its very words, "And this defendant further answering on information and belief avers that long before any invention by said Bell of the alleged improvement specified as his invention in said Letters Patent Numbered 174,465, the same was known and used by the following persons at the following places, to wit:" and your name is given as one.

A. Yes, sir; I don't testify with regard to the other men; I testify with regard to myself.

X. Int. 107. Then you testify with regard to yourself do you, that the invention specified in Bell's patent No. 174,465 was known and used by you before the date of his letters patent?

A. An invention equivalent to that was used; not the same invention.

X. Int. 108. And you think the Reis telephone is the equivalent of that?

A. I think a great deal better than the one described in that patent.

X. Int. 109. Then you think the Reis telephone is not only equivalent but a much better invention?

A. Better than the one described in the patent upon which that suit was based.

X. Int. 110. And that is what you meant when you had this answer drawn in that language?

A. I meant that I had made a speaking telephone before that.

X. Int. 111. Did the defendants in that case call any one

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of the number of persons as witnesses who it is said in the answer knew of and used the Bell invention before the date of his patent?

A. I don't know.

Counsel for complainant gives notice that he will put in evidence the entire record in the case of the American Bell Telephone Company vs. A. K. Eaton and others, in Southern District of New York.

Defendants' counsel requests that if the record in the New York case is put in, that the record in the Spencer case which was defended by the Eaton Company, and from which counsel has been reading to the witness, shall also be put in.

Counsel for complainant says, that he does not propose to encumber his record with the whole Spencer case, but if counsel for defendant wishes it in the case, it will give counsel for complainant great pleasure to have him put it in.

Counsel for defendant says that by stipulation the whole record in the Peoples case and the whole record in the Molecular case are in this case, and that if counsel for complainant proposes to put in the Eaton case, and with a view to their putting in that case he puts in evidence the record in the Spencer case.

Mr. Dickerson asks Mr. Paddock (a former witness herein) who was in the room, whether he was a director in the company, and he said he was not.

Defendants' counsel asks Mr. Paddock: Are you a director or stockholder in any telephone company?

Mr. Paddock: I am not a director or stockholder in any telephone company, and have no interest whatever in any telephone company.

Charles A. Young, recalled for defendants for further examination.

Examined by Mr. Keasbey:

Int. 1. Will you state briefly and comprehensively your opinion of the relation between the Reis transmitter and the modern microphone?

> Counsel for complainant objects to any essay of Prof. Young about his opinion on those questions, it being not of the least consequence in the world what their relation may be, and is, therefore, entirely irrelevant.

A. My opinion is that there is no essential difference in principle between the action of the Reis transmitter and of any microphone transmitter. The action of the Reis transmitter, when used for the transmission of speech, is in my opinion identically the same with that of any modern microphone.

Int. 2. How about the Reis receivers?

A. I consider that in the various forms of the Reis receivers we find all the essential elements of successful telephone receivers, and with modern microphone transmitters they will receive speech perfectly well; as the Reis transmitters will transmit speech very satisfactorily with modern receivers.

Int. 3. What is your opinion as to the correctness of the theory that speech cannot be transmitted by makes and breaks, but only by the actual changes of resistance or electro-motive force?

A. I do not accept the theory. Speech can be transmitted by such gradual changes on the magneto telephone. In the case of the microphone transmitter, I should not be prepared to assert or deny any of the theories held with reference to their action. I believe that speech can be transmitted by a series of breaks properly spaced and timed, and this, because I have heard the word "Hollo!" transmitted by a wheel of Mr. McDonough's described in my previous

testimony, and I am confirmed in my opinion by complete experiments made by Prof. Brackett and myself.

Int. 4. You refer to experiments made in connection with Prof. Brackett. How far were they successful and how did you prosecute them to completion?

A. They were so far successful that we obtained indistinct articulation of two words directed to the telephone, something such as Mr. Dickerson's speech when his hand was before his mouth—the words were intelligible but couldn't be called good articulation. When we had reached that point in our experiments the funds at our disposal for experiments gave out, and at the same time both Prof. Brackett and myself were subjected to a great pressure of other matters that had been neglected in consequence of these experiments. We intended to resume these experiments as a matter of scientific interest without pecuniary compensation during the past summer vacation, but the death of Mrs. Brackett and Mr. Brackett's departure for Europe prevented it.

Int. 5. So far as you went in these experiments did you find anything to contradict your former ideas?

A. No, sir; we did not. We found, however, very great difficulty in ascertaining precisely what the proper timing and spacing of the breaks should be. We obtained traces of vibrations corresponding to words, but the same words spoken by different individuals showed such a great difference in the tracing that we found it extremely difficult to pick out what was essential to the word in question and what was peculiar to the speaker.

Int. 6. Are you, Professor, interested in any telephone patent or telephone company of any kind?

A. I am not, pecuniarily.

No cross-examination.

Eliphalet W. Smith, recalled for further examination on behalf of defendants.

Examined by Mr. Keasbey:

Int. 1. Are you the same person who was sworn in these suits in July of last year.

A. I am.

Int. 2. Are you still living in Newark?

A. I am living in Newark.

Int. 3. Were you requested by me to assist Mr. John R. Paddock in certain experiments with various telephone instruments during the past summer?

A. I was requested so to do, and I have been assisting Mr. Paddock in experiments at East Orange, New Jersey.

Int. 4. Have you read the statement of Mr. Paddock which has been given in evidence as to the nature and results of those experiments?

A. I have read the statement.

Int. 4½. So far as that statement alleges your part of those experiments and states what you transmitted or received during the course of the experiments, is it correct?

A. It is correct.

Int. 5. That statement gives various communications of articulate speech given by the instruments known as numbers one, two and three, in the course of these experiments as transmitted and received by you and Mr. Paddock in connection with each other. Did you transmit and receive those sentences of articulate speech through those instruments in the manner stated by Mr. Paddock?

A. We did so transmit those words and sentences as given by Mr. Paddock.

Int. 6. Did you take pains to verify the truth of each word transmitted, carefully?

A. We were very careful, and verified everything that we did.

Int. 7. Are you experienced in the matter of transmitting speech by telephone?

A. I have had considerable experience in telephones; both with Bell's instruments and other instruments.

Int. 8. In that statement it is said that with the instruments constructed by you which are put in evidence, the

following sentence was transmitted and received, the last sentence being: "Hollo, Mr. Smith. Where are you going this summer for a vacation. Have you ever been to the Adirondacks. Have you ever been to Blue Mountain Lake. You can take the boat at New York and go to Troy and then by railroad to Whitehall, and from Whitehall by steamer through Lake Champlain. Hollo; did you get all that," and consisting of fifty-six words. Mr. Paddock says that he transmitted that long sentence, and that you came to the transmitting room and said that you received every word of it, and repeated it to him. Is that true?

A. That is true.

Int. 9. Was that whole long sentence continuously transmitted by those instruments?

A. It was transmitted as well and as distinctly as it could have been by any ordinary transmitter; not so loud, but still distinct enough to be understood without any difficulty.

Int. 10. Is there any room for supposing that that could have been due to the imagination?

A. I think there is no room for supposing anything of that kind. I had no knowledge whatever of what he was going to say, and I have never heard him speak before of the Adirondacks or of Blue Mountain Lake, and did not know that he had ever been there or had any knowledge of the place, except such as he might get from a map.

Int. 11. Can you state positively, from your experiments with these instruments offered in evidence to-day, that the Reis instrument, as constructed by you and used by you and Mr. Paddock, will transmit and receive articulate speech?

A. I am satisfied that the Reis instrument, as constructed by me and as used by us, will transmit speech. I am satisfied that the speech transmitted by the Reis receiver is not of good quality—not as good as when received by a magneto receiver, but it is sufficiently distinct to be understood at times.

Int. 12. Did you assist Mr. Paddock in his experiments yesterday and the day before with the instrument known as

the Reis-Frankfort instrument—transmitter and receiver?

A. I did assist Mr. Paddock in these experiments.

Int. 13. Have you heard Mr. Paddock's statement of the result of your experiments with that Reis-Frankfort instrument?

A. I have.

Int. 14. Where was the receiver placed?

A. The receiver was placed in Mr. Paddock's stable, I should think about a hundred and fifty feet from the room in which the transmitter was placed.

Int. 15. And where was the transmitter placed?

A. In an upper room in Mr. Paddock's residence.

Int. 16. Was there any possibility of hearing between the two rooms?

A. There was no possibility of hearing between the two rooms.

Int. 17. Did you receive or transmit, or both?

A. Both.

Int. 18. You have heard Mr. Paddock's statement of the words transmitted and received by you and him together during those experiments. Can you state whether those statements are correct?

A. The statements are substantially correct, I think, as far as they go.

Int. 19. Did you actually hear articulate speech, words and short sentences transmitted from that Reis-Frankfort transmitter in Mr. Paddock's room through that receiver placed in the stable?

A. I actually heard words and fragments of sentences transmitted by that transmitter and received through the Reis receiver with sufficient distinctness to be recognized.

Int. 20. Did you use on that transmitter the adjusting screw which is shown?

A. We did not. We found that it was of no use there and consequently we removed it. I don't know but we did try it two or three times with it on and we found that it didn't make much difference whether it was on or not.

Int. 21. Did you ever see that instrument before Wednesday of this week?

A. I never did before.

Cross-examined by Mr. Storrow:

X. Int. 22. Is the Reis-Frankfort instrument in the same condition as it was when you used it as you have testified?

A. It is in the same condition; all the parts are there except that we removed this adjusting screw most of the time.

X. Int. 23. Please remove the screw now. Is the platinum point and the platinum patch in contact, now that the screw is removed?

A. It is in contact now.

X. Int. 24. What keeps that in contact?

A. I would say the manner in which we adjusted it was by loosening the binding post screw.

X. Int. 25. What keeps that in contact now?

A. The pressure of the binding post upon the spring.

Defendants' counsel offers in evidence a printed circular dated New York, December 20th, 1878, from the office of the Bell Telephone Company, signed, Theodore N. Vail, Manager, as follows:

"We take pleasure in announcing to our agents, customers and to the public, that we are now ready to furnish a battery-transmitting telephone, in addition to, and to use in connection with our ordinary magneto telephone.

"In the magneto telephone, the sound waves are thrown against and vibrate a diaphragm which acts as the armature of a permanent magnet, and disturbing its magnetic field, produces in the helix, or coil, surrounding the magnet, undulatory currents of electricity, which are conveyed over the line, and corresponds to and reproduces the articulation in the receiving telephone. Any magneto telephone can be used either as a transmitter or receiver.

"In the battery transmitting telephone a voltaic current is passed through conductors which are connected to the dia-

phragm. These conductors offer a certain resistance to the current, and are so arranged that the vibrations of the diaphragm caused by the sound waves vary this resistance with every wave, thus producing undulations in the current which correspond to and reproduce the articulation. This, however, requires a magneto telephone as receiver.

"The battery transmitter acts more owerfully, for the reason that voltaic electricty is a force much stronger than the magneto electric current when ordinarily produced by the telephone, and on that account the faintest articulation can be transmitted with the utmost distinctness.

"It is not probable, however, that the battery transmitter will take the place of the magneto telephone, for the latter is simple in its construction, durable and reliable under all circumstances, can be used for both transmitting and receiving, costs nothing to maintain, is sufficiently loud and distinct and will probably be the most popular instrument for general use.

"The battery telephone, though possessing the advantage of louder articulation, and not being liable to get out of order under ordinary circumstances, is more delicate and complicated in its construction, requires the maintenance of a battery in connection with it, the attention occasionally of an electrical expert, and can only be used as a transmitter, thus requiring a magneto telephone as a receiver. It will be used principally in the large cities where the induced currents from telegraph or other wires interfere materially with the weaker currents of the magneto telephone, also in transmission of messages over long distances, or where, for special reasons, a greater volume of sound is necessary to be obtained.

"Very respectfully,

"THEO. N. VAIL, *General Manager.*"

Defendants' counsel puts in evidence the whole examination of Prof. Cross in the case of the American Bell Telphone Company vs. The Baxter Overland

Telephone Company, taken in Boston, in April and June, 1885, together with the exhibits presented with his examination.

Defendants' counsel thereupon announced that the taking of proofs for defendants was closed.

DEPOSITION OF CHARLES R. CROSS.

BOSTON, April 30, 1885.

Direct Examination by GEORGE L. ROBERTS, Esq., *of Counsel for Complainants.*

Int. 1. State your name, age, residence, and occupation.

Ans. Charles R. Cross; I am thirty-seven years old; I live in Boston, and am Thayer Professor of Physics in the Massachusetts Institute of Technology.

Int. 2. How long and to what extent have you been engaged in the study of the physical sciences, and to what extent, if at all, have you been accustomed to make experiments in the several branches of physics, especially those relating to electricity and acoustics?

Ans. I have been an instructor at the Institute of Technology during the past fifteen years, and during that time I have been constantly engaged in the study of various branches of physics. During the past eleven years I have especially investigated the subjects of acoustics and certain branches of electricity. In the prosecution of my studies during this time I have constantly been engaged in the experimental study of the subjects mentioned, and have been practically familiar with all the apparatus ordinarily used by scientific men in the investigation of sound and electricity.

Int. 3. What attention have you given to the speaking telephone, and to its principles and mode of operation?

Ans. I have been familiar with the rise and development of the speaking telephone from its very beginning, having been in frequent communication with Prof. Alexander Graham Bell ever since the winter of 1873–74. I am familiar with Mr. Bell's patents, have investigated with great care the theory upon which these patents are based, and am practically familiar with the construction and use of the various forms of instruments constructed in accordance with said patents. During the past six years I have conducted a very extensive series of experiments relating to the different branches of telephony, in the capacity of expert for the American Bell Telephone Company.

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Int. 4. Have you given attention to that form of telephonic transmitter which operates by varying the resistance of a circuit?

Ans. During the last five years I have given special attention to the theory and operation of variable-resistance battery transmitters. I have made a large series of original experiments and investigations upon the subject, more extensive than any that I have ever seen in print. I have carefully studied the distinctions which exist between variable-resistance battery transmitters and circuit breakers, as well as the differences in the electrical and acoustic effects which they produce in the line wire and in the receiving telephone.

Int. 5. Have you heretofore testified as a witness in any cases in the courts of the United States, upon the principles of the inventions set forth in patents and embodied in machines or apparatus?

Ans. I have done so frequently.

Int. 6. You say you have been familiar with Mr. Bell's patents; state whether or not among these patents are those which have been introduced in evidence in this case marked "Exhibit Bell Patent No. 174,465," and "Exhibit Bell Patent No. 186,787."

Ans. The patents No. 174,465 and No. 186,787 are among those which I have had frequent occasion to examine.

Int. 7. Referring to the patent No. 174,465, will you explain the mode of operation of the apparatus referred to in the fifth claim of the patent, explaining, as far as may be necessary, the character of sounds, their action upon the apparatus, and the manner in which the apparatus operates to produce the results which are ascribed to it in the patent?

Ans. The sensation of sound is produced by the action upon the ear of the vibrating particles of air which are set into a vibratory or to-and-fro motion by the vibrations of the sounding body. The primary impulse given by the sounding body to those particles of air immediately in contact with it is gradually transmitted from particle to particle, in consequence of the elasticity of the air or other medium through which the sound passes. In consequence of the mode of action of the elasticity of the air, the motion originally communicated to the particles of air in contact with the sounding body is not transferred instantaneously to all the other particles; but in consequence of their inertia, as the sounding body vibrates

to and fro, a similar movement is impressed upon one after the other of the particles surrounding it. This to-and-fro motion of the vibrating body generates a similar minute to-and-fro motion of the air particles, so that they are alternately crowded more closely together, and separated more widely from each other, thus producing alternate condensations and rarefactions in the air. It is to these alternate condensations and rarefactions that the term "sound wave" is given. It will be observed that each particle vibrates to and fro in a straight line in the direction in which the wave motion is propagated. If we consider that the vibration of the air particles is produced immediately by the vibration of the sounding body, we see that the motions of the air particles must be a perfect copy of the motions of the particles of the vibrating body. Such vibrations may differ in three separate ways; viz., in the extent of the path of the vibrating particle, in the frequency of its vibration and in the character of its vibration. It is evident, in the first place, that the vibrating particle may, in its to-and-fro motion, traverse a longer or shorter path; in the second place, it may traverse this path a greater or less number of times in each second, that is, its rate of vibration may differ; in the third place, while traversing its path it may move according to different laws of acceleration or retardation of its velocity; for example, its acceleration during a part of its course may be and in some cases is constant, or the rate of acceleration may constantly change, and the law of its change may vary in different ways. To the changes in the motion thus caused, what I have called the peculiar character of the vibration is due. If we consider these three kinds of variation in their effect upon the senses, we find that variations in the extent of the path or amplitude of vibration of the particle determine, other things being the same, the loudness of the sound; the variations in the frequency of vibration determine the pitch of the sound; and variations in the character of the vibration determine what is known as the quality or *timbre* of the sound.

In the statements which I have just made I have spoken of the motion of a single particle; but it is evident from the mode of transmission of sound that all of the particles of the air through

which the sound is conveyed partake of the various characteristics of vibration which I have discussed.

I have used the term "quality or *timbre*." Quality is that peculiarity of a sound by which, independently of its pitch or loudness, we are enabled to determine the instrument by which the sound is produced; thus, for example, the note of a violin differs from the note of a flute in quality, even though the two are the same in pitch and loudness.

It is well known to scientific men that these differences in quality, which, as I have said, are due to differences in the character of the motions of the vibrating particle, are produced acoustically by the combination of a number of separate or partial tones, which can be shown to be produced when a particle is in vibration, and which partial tones differ in number, in pitch and in intensity or loudness, in accordance with differences in the character of the motion of the vibrating air particles.

The lowest of these partial tones is called the "fundamental," the other and higher notes "overtones." Hence, it is evident that the quality of a sound depends upon the relative pitch, intensity and number of partial tones present. In a very few exceptional cases only the fundamental is present, and what is called a simple sound is produced. In general, the pitch of a note is determined by the fundamental, the overtones determining the quality.

I quote from a standard work on acoustics by Prof. W. F. Donkin, published, Oxford, 1870 (p. 11):—

"When we speak of the pitch of the note produced by a string or an organ pipe, we mean in fact, the pitch of the gravest simple tone in the combination. This particular component is in general louder than any of the others, and is that on which attention is fixed. The others become associated with it by habit, and seem only to modify its character without destroying the unity of its pitch."

These facts, constituting what is known as Helmholtz's Theory of Quality, were first discovered by the physicist whose name the theory bears, and were published by him more than twenty years ago. The human voice owes its peculiar quality to the presence of great numbers of these partial tones; and very slight changes in the partial tones will produce very considerable changes in the voice.

I quote from the English translation (Ellis's), published at London in 1875, of Helmholtz's great work "*Die Lehre von den Tonempfindungen*":—

"Human speech employs these very qualitative varieties of tone in order to distinguish different letters" (p. 28).

. . . . . .

"On inquiring to what external physical difference in the waves of sound the different qualities of tone correspond, we must remember that the amplitude of the vibration determines the force or loudness, and the period of vibration the pitch. Quality of tone can, therefore, depend upon neither of these. The only possible hypothesis, therefore, is that the quality of tone should depend upon the manner in which the motion is performed within the period of each single vibration" (p. 28).

. . . . . .

"Every different quality of tone requires a different form of vibration" (p. 32).

From what I have said thus far, it will be seen that, in order to reproduce articulate speech, we must be able to reproduce in the air, vibrations which shall possess the same characteristics of pitch, intensity and quality — that is, of rate of vibration, amplitude of vibration, and character of vibration — which are possessed by the vibrating particles of air which are set in vibration directly by the organs of speech. If we can determine the speed and direction of motion of an air particle at each instant, and hence also the extent of its path, we can evidently impress upon it all three of the characteristics that I have mentioned; and hence can produce any desired sound at will.

In Mr. Bell's patent No. 174,465 a method is described by which the motions which are produced in the air at one place, the transmitting station, can be reproduced by an electrical method of intercommunication at the receiving station. By means of his invention he is able, by the use of certain electrical apparatus, to impress upon the particles of air at a distant place, the receiving station, motions substantially identical with those which are immediately impressed by the voice upon the particles of air at the transmitting station.

According to the specification, he effects this result by the use of the transmitter, which takes up from the air at the transmitting sta-

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tion the motions which are impressed upon it by the voice of the speaker, and the vibrating portion of which transmitter moves in substantial accordance with the movements of the air particles themselves. This transmitter being connected with a line wire joining the two stations between which speech is to be transmitted, is enabled by its electrical connection with that wire, to produce in it electrical variations which correspond to and are similar in form to the motions of the movable part of the transmitter, and hence to the motions of the air particles which have actuated the movable part of the transmitter. These electrical variations, in their turn, set in motion a movable part of a receiving instrument with which the line wire is connected, and, in their turn, produce in this movable part of the receiver, vibrations corresponding to and similar in form to those electrical vibrations by which they are produced, and hence to the motions of the air particles at the transmitting station. The movable part of the receiving instrument, thus vibrating, impresses upon the air at the receiving station, vibrations similar in form and corresponding to its own motions.

The motions thus produced in the air particles at the receiving station are therefore evidently similar in form and correspondent to the original vibrations impressed upon the air at the transmitting station by the voice of the speaker at that station. This being the case, it is evident, from what I have said, that the sound uttered by the speaker at the transmitting station will be reproduced at the receiving station.

It appears from these facts, that Mr. Bell's apparatus consists essentially of a transmitter adapted to take up the vibrations of the air at the transmitting station; a line wire connecting the transmitting with the receiving station, together with a battery or some other form of electrical apparatus which is capable of furnishing a supply of electricity, which line wire shall serve to transmit the electrical variations produced by the transmitter from one station to the other; and a receiver which, actuated by the electrical variations thus transmitted by the line wire, shall be caused to reproduce the motions of the transmitter and of the air particles by which that transmitter is actuated. It is true that the receiving instrument may not always reproduce the vibrations of the air particles at the

transmitting station in every minute detail, but the instrument is a speaking telephone only so far as it is adapted to reproduce those motions with substantial fidelity; and its practical construction and operation must be such that these vibrations shall be substantially reproduced.

It is evident that when the transmitter is in operation, variations in the electrical current may take place in three ways, — there may be a variation in either the direction of the current, the rate or violence of change of the current, and the frequency of change of the current; and from these three kinds of variations similar variations in the direction, rate and frequency of change of the motion of the movable part of the receiver will result. And hence, from these different electrical variations, differences in the quality, intensity and pitch of the sound produced by the receiving instrument will follow. Therefore, to reproduce articulate speech or any other sound in all its characteristics of pitch, intensity and quality, it is necessary that the movable portion of the receiving instrument shall be constantly under the guidance of and controlled by the movable portion of the transmitting instrument; and in case this constant control is not exercised, and in precisely that degree in which it ceases to be exercised, the instrument becomes incapable of transmitting articulate speech.

No form of transmitter which operates by making and breaking an electrical circuit can possibly transmit articulate speech or any other sound in its different characteristics of pitch, intensity and quality, for the reason that the constant control, of which I have spoken, is not exercised in such an instrument. With any circuit-breaking instrument the loudness and quality of the sound produced at the receiving station are dependent solely upon the physical construction and action of the receiving instrument itself, and of the battery or other source of electricity by which the transmitter is acted upon. The intensity and quality of the sound produced at the receiving station are, therefore, with such an instrument, entirely independent of the intensity and quality of the original sound produced at the transmitting station. It is for this reason that an instrument of this class, such as, for example, the well-known Reis instrument, operating in the manner described, is incapable of trans-

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mitting either intensity or quality, and hence is incapable of transmitting articulate speech.

As will be seen from what I have already said, the Reis transmitter, or any other transmitter which operates by making and breaking the circuit, is capable of transmitting pitch, and pitch only.

I quote further, from the English translation (published 1875) of Helmholtz's great work: —

"*Pitch depends solely on the length of time in which each single vibration is executed, or*, which comes to the same thing, *on the vibrational number of the tone.* We are accustomed to take a second of time as the unit, and consequently mean by *vibrational number*, the number of vibrations which the particles of a sounding body perform in one second of time" (p. 17).

The essential difference between the electrical changes produced by the Reis transmitter and the changes produced by the apparatus, Fig. 7 of the Bell patent No. 174,465, when spoken to, is that the action of the Reis apparatus serves to break up into successive and disjunctive fragments a current of substantially uniform strength. This is a merely intermittent current. The frequency of its intermittences is the same as the frequency of the air vibrations which give rise to what is known as the pitch of the sound acting upon the transmitter. The apparatus, Fig. 7 of Mr. Bell's patent, on the other hand, produces when spoken to a series of electrical changes which in their character correspond to and substantially copy the changes which take place in the air performing the sonorous vibrations to be transmitted. The apparatus of Reis was intended to produce mere intermittences, the frequency of which corresponded to the pitch of the sound transmitted. The apparatus of Bell, on the other hand, was not intended to produce intermittences: nor is its operation due to their production. The declared purpose of the invention is to produce electrical variations, which in their form copy the vibrations of the air. This is the distinction between the mode of operation of one apparatus and the mode of operation of the other. It is the employment of the electrical changes due to and constituting one mode of operation as distinguished from the other, that is insisted upon by Mr. Bell in his patent and specified in his claim. It is because Mr. Reis employed the one mode of

operation that his apparatus is not a speaking telephone, and it is because Mr. Bell employed the other that his apparatus is.

There is also another reason which prevents a Reis transmitter or other circuit-breaking instrument from transmitting articulate speech; this is the effect of the interruptions of the current in producing a loud and disagreeable noise in the receiver, which of itself would be sufficient to overpower and obliterate those fine shades of variation upon which differences in quality depend.

In fact, this noise is so marked that an ordinary battery transmitter can be used as a telephonic call by so operating it as to cause it to actually make and break the electrical circuit. Under these circumstances, the noise which proceeds from the receiving instrument, which, when the transmitter is used in a normal and proper manner, can be heard only by one close to the instrument, is capable of being heard throughout a large room.

Int. 8. You have described the operation of a speaking telephone apparatus when transmitting speech as set forth in the specification of Mr. Bell's patent No. 174,465. Will you now state briefly what is the function and importance of the similarity between the vibrations of the air accompanying sounds uttered into the transmitter and the electrical undulations which are caused in the apparatus while transmitting speech, as particularly referred to in the fifth claim of Mr. Bell's said patent, which is as follows: —

"5. The method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth"?

Ans. It is because of this similarity that speech is transmitted. In a perfect instrument the motions of the receiver are both the effect and a copy of these electrical variations. Since these electrical variations are a copy of the motions of the transmitter, it follows that the motions of the receiver are a copy of those of the transmitter; if substantially this action takes place, speech is transmitted, otherwise speech is not transmitted.

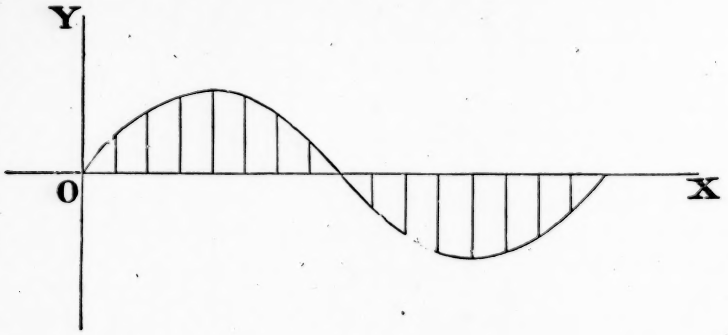
Int. 9. You speak of the sound waves, and explain the mode in which they are produced. Do you understand that the actual exist-

ence of these sound waves has been demonstrated, or is accepted as a fact by scientific men?

Ans. The existence of such sound waves has been accepted as a fact by scientific men for several hundred years. Within a few years past they have been visibly shown to exist, by a method which demonstrates the existence of alternate condensations and rarefactions to the eye.

Int. 10. Has any method of representing such waves been adopted; and if so, what is it?

Ans. It is customary among physicists to represent the motions of the particles of a sound wave, and also the variations in condensation and rarefaction at different points in a sound wave, by a graphical method. I can best illustrate this by reference to a diagram which I produce, to be incorporated in my answer.



The curve in the diagram is what is called a sinusoidal curve, such as corresponds to the sound waves produced by a simple sound, consisting of a single note without overtones. Such a sound can be produced by a tuning fork, mounted on a resonant case, and bowed in a manner suitable for this purpose. O X is divided into a number of equal spaces, to represent equal periods of time. The length of these spaces is purely arbitrary. The distances from O to the beginning of any one of these divisions are called *abscissas*. From each of these points on O X, representing successive intervals of time, lines are drawn parallel to O Y, and proportional in their relative lengths to the distances of the particle from the point of rest at the successive periods of time.

In the case of the particle pursuing a simple vibration, these magnitudes will increase to a maximum, which will be attained at the instant when it reaches the extremity of its path; they will then diminish as it comes back to the starting point; and as it passes beyond it, moving in the other direction, they will be indicated by distances measured off below the line O X. Joining then the extremities of the perpendicular lines, we obtain a broken line somewhat resembling a curve; and if we put the perpendicular lines close enough together, the broken line joining their extremities becomes a curve. This curve is determined by the length of two sets of lines or distances, — the *abscissas* measured on O X, and the *ordinates* measured parallel to O Y. In the case stated, the starting point is assumed to be in the middle of the path (*e. g.*, the position of a pendulum when at rest), and the motion is measured in both directions from it; *i. e.*, the curve is on both sides of the line, and part of the ordinates have one direction, part the other. But the point from which the measurements are taken is purely arbitrary; and the line O X, which represents this point, might be placed lower down and tangent to the lowest part of the curve. In that case the curve would not change its character, but the ordinates would all be measured in one direction and on one side of O X. Algebraically expressed, they would all be + quantities, instead of being alternately + and — quantities, in the two branches of the curve; only the + quantities would be greater than shown in the diagram. In the case indicated by the diagram, we should consider that an increase in the length of the ordinates, in passing from one to the next, signified motion in one direction, and a decrease signified motion in the other direction. In this method of representation one set of lines, measured along O X, corresponds to the period in which the movement is executed, or its frequency; and the other measured along O Y, to the amplitude or extent, and also to the direction of the motion; and these measurements express frequency, amplitude and direction. The same curve will represent the extent of rarefaction and of condensation of the air produced by the movement of the particles, and also, when correctly interpreted, the motion and the varying velocity of the particles.

It is from this habit of graphical expression that a vibration is

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commonly spoken of among physicists as having "form"; form of vibration is a phrase used to signify the "character" of a vibration, as I have explained it.

It must be remembered that this curve does not represent the path of the moving particle; that always moves to and fro in a straight line. This curve is merely a convenient form of expressing to the eye the character and variation of the motion.

I quote again from the work of Helmholtz: —

"To render the law of such motions more comprehensible to the eye than is possible by lengthy verbal descriptions, mathematicians and physicists are in the habit of applying a graphical method, which must be frequently employed in this work, and should therefore be well understood" (p. 29).

The writer then describes the method of drawing acoustic curves, and continues: —

"Physicists, then, having in their mind such curvilinear forms representing the law of the motion of sounding bodies, speak briefly of the *form of vibration* of a sounding body, and assert that *the quality of tone depends on the form of vibration*" (p. 32).

. . . . . .

"I have by no means unfrequently found even physicists start on the false hypothesis that the vibrational form must exhibit little waves corresponding to the several audible upper partial tones" (p. 53).

. . . . . .

"The reader must bear in mind that when we apply the term 'compound' to the vibrations produced by a single musical instrument, the 'composition' has no existence except for our auditory perceptions or for mathematical theory. In reality, the motion of the particles of the air is not at all compound; it is quite simple, flowing from a single source" (p. 189).

Int. 11. If you can produce from any scientific work a diagram representing the manner in which overtones are combined with a fundamental to give quality to sound, different from that due to the fundamental alone, and representing the form given to the curve as the result of all the vibrations, will you do so, stating the source from which you derive it, and explaining, as far as you think necessary, the diagram?

Ans. The following diagram, taken from "Mayer on Sound," p. 153, represents the motion of a particle under the influence of sound waves: —

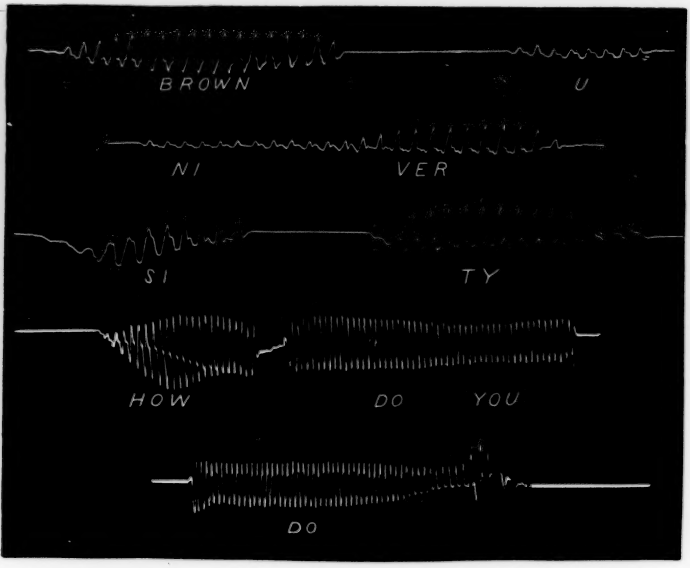
The curves at *a b* represent six sound waves of six simple sounds. When these are sounded together as fundamental and overtones, and with relative intensities corresponding to the amplitude of the curves, as drawn, so as to produce a sound having the quality due to this combination, the vibrational "form," as it is called, of the sound perceived by the ear is represented by the curve at *c d*. The set of vibrations which constitutes one complete vibration is shown twice between *c* and *d*. The entire "form" or character of this curve can be determined and controlled, as already stated, by determining or controlling for each point the length of the abscissa and of the ordinate for that point, or in other words, determining or controlling the elements of time or frequency, amplitude or intensity and direction; but it is obvious that it will require very many measurements of abscissas and ordinates to determine or control the "form" of each complete set of vibrations.

The curve representing one set of vibrations is about three inches long; and it is apparent, even to a casual observer, that by taking the ordinates as little as one eighth of an inch apart, we should miss the little twists, which most strikingly represent to the eye the "quality" or the effect of the overtones in this vibrational form, and which are equally important to the "quality" of the sound as per-

ceived by the ear; and, as in the articulate speech of a woman, there are twenty-four thousand of these *complete* sets in a minute, it will be obvious that in order to reproduce this vibration the control must be exercised, not merely twenty-four thousand times a minute, but really without any interruption or cessation whatever.

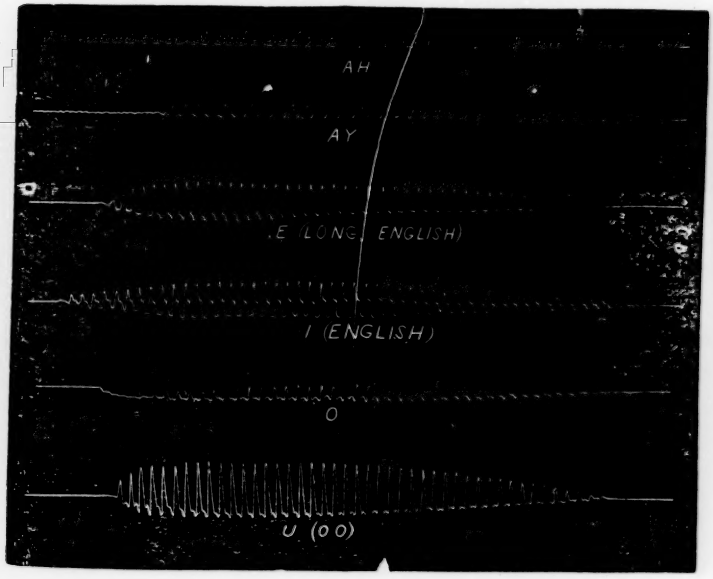
Int. 12. If observations have been made upon the curves produced by spoken words, and you can produce a diagram representing the results of such observations, will you do so, giving the authority from which they were made?

Ans. The minute changes which take place during articulation are well shown in a series of curves made by Prof. E. W. Blake,



Jr., of Brown University, and described in *Silliman's Journal* for July, 1878. These curves were produced by reflecting a ray of light from a mirror so attached to the plate of a speaking telephone that the vibrations of this plate were communicated to the mirror. The reflected ray is caused to act photographically upon a sensitized plate of glass, the mirror at the same time being caused to vibrate by the action of the voice upon the telephone plate. On rapidly moving the plate of glass in a direction at right angles to

that in which the reflected ray was caused to vibrate by the vibrations of the mirror, a photographed representation of the complex vibrations of the mirror was produced.



In Prof. Blake's figures the vibrations characteristic of different vowels, and the rapidly changing vibrations produced in the case of a spoken sentence, are very beautifully shown. According to the statement made by Prof. Blake in the article referred to, the vibrations are magnified in the accompanying cuts one hundred and twelve times. Notwithstanding the accuracy of Prof. Blake's drawings, the mere thickness of the lines in the woodcut is sufficient to obliterate many of the more delicate variations in those vibrations which characterize articulate speech.

Int. 13. Referring again to the first Bell patent, No. 174,465, to which your attention has been called, will you state what the moving parts are which you have referred to as being put in motion by sound waves, or by variations of currents produced by sound waves?

Ans. In Fig. 7 the transmitter possesses a movable armature, *c*, one end of which is hinged, while the other is so attached to a mem-

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brane at *a* that when this membrane is set in vibration by the utterance of a sound into the cone A, the armature shall be caused to take up the vibrations of the membrane. By the vibration of this armature, as it approaches nearer to or recedes from the pole of the electro-magnet *b*, in accordance with the well-known laws of magneto-electric induction, electrical undulations or waves are produced in and transmitted by the line wire *e*. The receiving instrument which is in electrical connection with the line wire possesses an electro-magnet *f*, whose magnetic strength varies in accordance with the electrical variations produced in the line wire in the manner described. In front of this electro-magnet of the receiver, and opposite its pole, is a vibratory armature of inductive metal, hinged at *k*, and connected at *i* with a membrane stretched over the larger end of the cone L, so that variations in the magnetic strength of the electro-magnet *f*, produced by electrical variations in the line wire *e*, produce variations in the armature *h*, and consequently in the attached membrane, so that this attached membrane vibrates in correspondence with the motions of the membrane of the transmitting instrument, and therefore in correspondence with the vibrations of the voice by which the membrane of the transmitter is actuated. I should have said that the vibrating armatures of both the transmitting and receiving instruments are of iron or other inductive metal; and I would also call attention to the fact that the hinged end of each of these vibratory armatures is in magnetic connection with that pole of the electro-magnet which is farthest from the vibrating part of the armature itself; this mode of connection serving to increase to a certain degree the magnetic strength of the apparatus.

Int. 14. Will you explain a little more in detail the functions of the battery represented in Fig. 7 of the Bell patent of which you have been speaking, and the manner in which the undulations in the current are produced in the apparatus represented in that figure, and in what way the undulatory current acts in the receiving instrument to produce the proper results?

Ans. The magnets *b* and *f* in Fig. 7 are electro-magnets, having soft iron cores, which cores are magnetic only when a current of electricity is passing through the coils surrounding them. The object of the battery shown in Fig. 7 is simply to produce this cur-

rent, which shall cause the cores to be kept magnetized. The armature *c* of the transmitter, which is of iron or other inductive metal, will, as it moves to and fro, alternately increase and diminish the magnetic strength of the magnet *b*. These variations of magnetic strength will correspond to the various changes in motion of the vibrating armature. In accordance with the well-known laws of magneto-induction, as discovered by Faraday, every change in the magnetic strength of the core of the electro-magnet *b* will produce corresponding changes in the current of electricity which passes through the line wire *e*. These variations in the strength of the current will cause corresponding variations in the magnetic strength of the electro-magnet *f*, and these variations in the strength of the magnet will act immediately upon the vibratory armature at *h*. An increase of strength in the magnet *f* will cause the armature to approach to the magnet, while diminution of magnetic strength will allow the armature, under the influence of the tension of the membrane to which it is attached, to recede farther from the pole *f*. Hence, under the influence of the varying magnetic strength of *f*, the vibratory armature at *h* will execute vibrations corresponding to these changes in magnetic strength, and therefore corresponding to the changes in the electric current in the line wire *e*, to the changes in the magnetic strength of the magnet *b*, and therefore corresponding to the variations in the motion of the vibratory armature at *c*, when moved by the vibrations of the membrane with which it is in contact. The membrane of the receiving instrument at *i* will therefore vibrate in correspondence with the membrane *a* of the transmitting instrument.

Int. 15. Please state briefly the principal scientific facts which you find set forth, and correctly set forth, in Mr. Bell's patent No. 174,465, of March 7, 1876, with reference to the apparatus shown in Fig. 7, and its operation, and which bear upon the question whether the patent, so far as that apparatus is concerned, is a patent for an electrical speaking telephone.

Ans. The speaking telephone is shown in Fig. 7 of the patent. In the body of the specification and in the claim, the patentee describes the nature of the operation which will take place when a sound is uttered into the transmitter by the human voice. I know,

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as a matter of scientific knowledge, that when spoken to this is the kind of operation which it theoretically will perform, and the only kind of operation which it theoretically can perform.

The patentee then asserts the consequence of that operation with that apparatus to be that a similar sound to that uttered into the transmitter is then heard to proceed from the receiver. This action is theoretically the necessary consequence of this operation of the apparatus. I know from actual trial, that this operation would be so well performed by a set of instruments constructed according to the instructions of the patent, and without further invention, that the listener at the receiving end will recognize and understand the words spoken at the transmitting end.

That feature to which the most prominence is given in the specification is the similarity of form between the sound vibrations which actuate the instrument and the electrical undulations due to them. This is expressely mentioned in the following sentences of the specification: "These undulations are similar in form to the air vibrations caused by the sound — that is, they are represented graphically by similar curves."

This is the only feature specifically mentioned in the claim, which reads as follows: —

"5. The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

This feature of similarity in form between the electrical undulations and the air vibrations producing them, secures the transmission of quality. It has no purpose, function or effect, except the transmission of quality, which includes articulate speech. This correspondence of form is the essential electrical novelty which distinguishes this apparatus from all others known to the community before it.

Int. 16. Do you find any mode suggested in the patent as an alternative one to that you have described, of producing the variations or undulations in the current between the transmitter and receiver; if so, will you quote from the specification the language which refers to such other mode?

Ans. It was well known to electricians, long before the date of Mr. Bell's first patent, that the strength of an electrical currrent can be varied, either by increasing the electro-motive force of the source of electricity or by diminishing the resistance of the circuit, and conversely, in accordance with the well-known law of Ohm,

$$\text{Strength of Current} = \frac{\text{Electro-motive Force}}{\text{Resistance of Circuit.}}$$

In the apparatus which I have described, Mr. Bell explains a mode of producing these electrical undulations by varying the electro-motive force. He also clearly recognizes the possibility of producing such undulations by varying the resistance of the circuit. In his specification No. 174,465, I find the fo lowing:—

"Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit. . . . The internal resistance of a battery is diminished by bringing the voltaic elements nearer together, and increased by placing them farther apart. The reciprocal vibration of the elements of a battery, therefore, occasions an undulatory action in the voltaic current. The external resistance may also be varied For instance, let mercury or some other liquid, form part of a voltaic circuit, then the more deeply the conducting wire is immersed in the mercury or other liquid the less resistance does the liquid offer to the passage of the current. Hence, the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current. The vertical vibrations of the elements of a battery in the liquid in which they are immersed produces an undulatory action in the current by alternately increasing and diminishing the power of the battery."

Int. 17. If electricians have been in the habit of stating, in algebraic terms, the law to which you have referred, will you give the form of expression which has been used, explaining the symbols, and state how long that law has been known, and whether or not it is one which has been found of use in the practical application of electricity?

Ans. The law of Ohm is usually expressed by a formula $C = \frac{E}{R}$, in which C is the strength of the current; E the electro-motive force, that is, the force producing the current; and R the total resistance of the circuit. Ohm's law was, if I recollect rightly, first stated by him in the year 1827. For the last thirty years its importance has been fully recognized by physicists, and it has been applied by

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constructors of electrical apparatus in determining the dimensions and arrangement of the different parts of such apparatus.

Int. 18. In your judgment, does the substitution of one of these ways of varying the current for the other substantially change the character of the described apparatus as an apparatus for transmitting sounds, or substantially change the method by which sounds are transmitted or reproduced.

[*Objected to as incompetent on the ground that the question involves, in part, a question of law, and a legal construction of the patent of Bell.*]

Ans. Speaking as a scientific man, I should say that it does not.

Int. 19. Have you examined and tested the instruments marked "Exhibit Defendants' Transmitter" and "Exhibit Defendants' Receiver" in this case? If so, for what purpose do you find them to be adapted, and what has been the result of your tests with them?

Ans. I have examined and tested the instruments referred to, namely, Exhibit Defendants' Transmitter and Exhibit Defendants' Receiver, and I find that they are, from their construction and method of operation, adapted, when suitably connected with a battery, to transmit articulate speech. I have, in fact, so connected them, and transmitted articulate speech by means of them.

Int. 20. When so connected and used for that purpose, what substantial likeness, if any, does the apparatus thus constituted, and the method by which it operates to transmit speech, bear to the apparatus and method described in the patent to Bell of which you have been speaking, and referred to in the fifth claim thereof; and in making this comparison, state whether or not in your judgment the defendants' said instruments, when so used, embody the invention described in said patent and referred to in said claim?

[*Same objection as to Int.* 18.]

Ans. The apparatus to which I have referred in my last answer, Exhibit Defendants' Transmitter and Exhibit Defendants' Receiver, when connected and so operated as to transmit articulate speech, use the method invented by Mr. Bell, and described in his specification No. 174,465, for transmitting vocal or other sounds telegraphically, by causing electrical undulations similar in form to the vibrations of the air accompanying such sound. The instruments in

question most certainly embody the invention which Mr. Bell describes in his specification referred to, and when used in the transmission of articulate speech constitute an apparatus which is substantially that described by him in his said patent in connection with Fig. 7 of the drawings and referred to in the fifth claim.

Int. 21. In the operation of transmitting speech in the defendants' apparatus, what is the importance of causing the electrical undulations to be similar in form to the sound waves?

Ans. Precisely the importance which is indicated in my answer to Int. 8. Any departure from similarity impairs the character of the speech to the extent to which it occurs; and when that departure or any extraneous disturbance reaches a certain point the sounds at the receiver cease to be intelligible as speech.

Int. 22. Will you compare these instruments, when so connected and used, with Mr. Bell's apparatus, to which you have referred, pointing out the functions and mode of operation of the several parts? And if you find that these instruments differ specifically from the Bell apparatus, explain the nature of the differences, and give your judgment as to their affecting the substantial likeness of this apparatus to the Bell apparatus and its method of operation.

Ans. In Mr. Bell's patent No. 174,465, I find a transmitting instrument, a receiving instrument, a line wire connecting these and a battery or other source of electricity. In the apparatus described, the transmitter possesses a movable part, which is capable of being set in vibration by the agency of the voice. This movable part is so arranged that it shall cause electrical variations in the current traversing the line wire. The receiver is so arranged that the variations of current referred to shall communicate motion to a movable part, which shall in its turn communicate motion to the air about it. As I have already shown at some length, the vibrations of this movable portion, when actuated by the sound waves produced by the voice, correspond to these in form, and by their action upon the receiving instrument cause it to vibrate in a similar manner, and hence produce corresponding vibrations in the air about the receiver. The function of the transmitter, it is evident, is simply to produce in the line wire electrical undulations similar in form to the vibrations of

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the air particles through whose agency they are produced. The function of the receiver is simply to translate, so to speak, the electrical undulations produced by the transmitting instrument and conveyed to the receiving instrument by the line wire, into vibrations of the air at the receiving instrument. Mr. Bell indicates that these electrical undulations may be produced either by varying the electromotive force of the current or by varying the resistance of the circuit.

In the exhibits specified I find a transmitter and a receiver, which when placed in electrical connection with each other by means of a line wire, and provided with a battery as a source of electricity, are adapted to transmit, and will transmit, articulate speech from one station to another.

In the defendants' battery transmitter I find an instrument, which, from its construction, is adapted to produce, and when properly operated by the voice, will produce, electrical undulations in the current traversing the circuit, similar in form to the air waves by which these electrical variations are produced.

In the defendants' receiver I find an instrument which is adapted to produce vibrations in the air similar in form to vibratians originally produced in the air at the transmitting station by the voice, as I have already explained. The defendants' apparatus, like the apparatus of the patent to Bell, contains a transmitter, which, from its construction, is adapted to produce electrical undulations as described, and a receiver which is adapted to retranslate these electrical undulations into vibrations of the air.

The defendants' battery transmitter adopts one of the modes mentioned by Mr. Bell as suitable for the production of electrical undulations similar in form to the air waves produced by the voice, namely, by varying the resistance of the circuit. The precise means adopted in the defendants' transmitter for varying the resistance of the circuit is different from the particular means referred to by Mr. Bell, inasmuch as it utilizes the property, possessed by various substances, of variation in resistance with variation in pressure.

In my opinion, however, the adoption of one rather than another particular way of varying the resistance of the circuit does not

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materially affect the substantial likeness of the apparatus of Mr. Bell and defendants, or its method of operation.

Int. 23. Will you state whether the fact to which you refer, that the resistance of substances may be varied by pressure, was one known before the date of Mr. Bell's patent, and recognized in the construction of electrical apparatus; and if you can refer to any electrical works of authority, where this fact is referred to, will you do so, and quote the references to the fact?

Ans. It was known long before the date of Mr. Bell's patent that the resistance of a circuit is varied, without being broken, by variations in the intimacy of contact or amount of pressure between two electrodes in contact, from one to the other of which a current is passing. This fact was noted and recorded by Du Moncel in his book, "Applications de l'Électricité," Vol. I. p. 246, edition of 1856, published at Paris in that year. In the "Comptes Rendus" for July, 1874, a communication from the same writer described some experiments as to the resistance offered to the current in passing from one electrode to another, in the case where one was a good conductor and the other a poor conductor, and showed that a moderate increase of pressure at the contacts would materially increase the conductivity, and thereby the current; and he gave his explanation for his phenomenon.

In Du Moncel, "Applications de l'Électricité," ed. 1856, Vol. I. p. 246, I find the following: —

"Une chose assez curieuse, et qui paraît être au premier abord en contradiction avec la théorie que l'on s'est faite de l'électricité, c'est que la plus ou moins grande pression exercée entre les pièces de contact des interrupteurs influe considérablement sur l'intensité du courant qui les traverse. Cela tient souvent à ce que les métaux de l'interrupteur ne sont pas toujours dans un état parfait de décapage au point de contact, mais peut-être aussi à une cause physique encore mal appréciée. Ce qui est certain, c'est que, dans les interrupteurs où la pièce mobile de contact est sollicitée par une force extrêmement minime, le courante éprouve souvent des affaiblissements assez notables pour faire manquer la réaction électrique qu'on attend d'eux."

Which I translate as follows: —

"A somewhat curious fact, which at first sight appears to be in contradiction to the views ordinarily received as to the action of

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electricity, is that the greater or less pressure exercised between the contact pieces of interrupters has an important influence upon the strength of the current which traverses them. This often happens, because the metal of the interrupter is not perfectly free from rust at the point of contact, but perhaps also because of a physical cause as yet but little appreciated. This is certain, that with interrupters in which a movable contact piece is acted upon by a very slight pressure, the current often suffers such an enfeeblement as to cause a failure in the electrical action which was expected."

The same writer describes, in the "Comptes Rendus" for July 6, 1874, a series of experiments in which he measured the current in a circuit, part of which consisted of a platinum electrode and a piece of wood, more or less damp, kept in constant contact, but with varying pressure, and says, p. 41, in an article entitled "Récherches sur les transmissions électriques à travers les corps ligneux," as follows: —

"Les expériences que j'avais à faire pour avoir une constation exacte des effets produits, étaient assez délicates, car une foule de causes étrangères peuvent intervenir, et changer les résultats fournis. Ainsi le dégré de serrage des plaques métalliques de communication avec le bois, son ivsolement plus ou moins parfait du sol et des murs de l'appartement, où l'on expérimente, la grandeur des surfaces mises en communication avec le circuit métallique, la masse du bois, l'état plus ou moins humide de l'air du cabinet des expériences, le contact fortuit des doights sur les fils de communication avec le gaivanomêtre, et l'état d'isolement de ces fils sont autant de causes qul peuvent modifier les résultats que l'on obtient.

. . . . . .

"6. Que le dégré de la pression de la plaque de platine contre le bois a tellement influé sur l'intensité du courant ainsi transmis, qu' étant de 12 dégrés avec un serrage maximum elle est devenue à zéro quand la plaque était abandonée à son propre poids, et à 5 dégrés seulement avec un faible serrage."

This I translate as follows: —

"The experiments that I have had to make in order to have an exact proof of the effects produced were very delicate, because a number of foreign elements might enter and change the results. Thus *the amount of pressure upon the metallic plates in communication with the wood*, its more or less perfect insulation from the earth or the walls of the room, the size of the surfaces put in communication with the metallic circuit, the mass of the wood, the greater or less humidity of the air of the experimenting room, the accidental

contact of the fingers with the wires leading to the galvanometer, and the condition of the insulation of these wires, were causes which might modify the results that would be obtained.

. . . . . .

"6. That the amount of the pressure of the platinum plate against the wood has so much influence on the strength of the current thus transmitted, that from twelve degrees, with a maximum pressure, it became reduced to zero when the plate was pressed only by its own weight, and to five degrees only with a slight pressure."

In Du Moncel's "Traité de Télégraphie Électrique," Paris, 1864, Part IV. p. 559, in speaking of apparatus designed to establish electrical contact, the author says: —

"L'expérience montre que plus la pression des contacts est grande, plus est energique l'intensité du courant qui les traverse."

That is, in English —

"Experiment shows that the greater the pressure of the contact pieces, the stronger is the current passing through them."

That fact was also constantly acted upon in the practical use of electrical apparatus; care was always taken that contacts should be firm and with considerable pressure, for otherwise the full and desired strength of current was not obtained.

Int. 24. State more particularly what you have meant by variations in pressure, as applied to the defendants' apparatus, and as applied to the experiments and statements of Du Moncel, which you have quoted.

Ans. By the variations in pressure which I have mentioned, I mean those variations because of which the contact pieces of hard carbon and platinum in the transmitter are pressed more or less closely together. I do not refer to these variations of pressure as producing change throughout the whole mass of the contact pieces, but simply to those variations which occur at the surfaces in contact. These are simply variations in the force by which the contact pieces are pressed together; and such variations produce variations in the electrical resistance of the joint thus made. The greater the pressure the more intimate is the contact and the less the electrical resistance, and *vice versa*.

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Int. 25. What name has been given to that part of a battery telephone which is made to operate by variations in pressure between contact pieces of carbon or other conductor, and what familiar instance of such a telephone can you mention?

In this connection, also, you may further explain the principle of its operation.

Ans. That variety of the speaking telephone transmitter which is referred to in the question is known as the articulating microphone, or, more generally, simply as the microphone. The form best known in commercial use is what is called the "Blake transmitter," invented by Mr. Francis Blake, and manufactured for general use by the Bell Telephone Company in the fall of 1878, and now universally employed in the United States.

The microphone consists physically of two electrodes placed normally in contact, with a slight pressure, and forming part of a circuit supplied with a current from a battery. A single Leclanché cell is generally employed in practice, though in some of my experiments with certain forms of microphone having large contact surfaces I have used as many as four Leclanché cells or two Bunsen.

One of the electrodes of the microphone is so arranged that when spoken to it will take up the vibrational movement of the sound waves. The other electrode is mounted so as not to be similarly affected by them; and the consequence is that the former electrode moves relatively to the latter. This motion of one electrode relatively to the other is excessively minute; but it is sufficient to so affect the current in the circuit that a magneto-receiver of the ordinary improved commercial form, conforming to the principles indicated by Fig. 7 of Mr. Bell's first patent, will audibly repeat the words uttered into the transmitter.

To aid in this operation of the transmitter, the electrode which is designed to be more directly vibrated by the voice is preferably made of such a shape as to offer itself some of considerable surface to the sound waves, or else is mounted upon an extended surface, such as a metallic diaphragm or a thin board.

There seems to be hardly any limit to the forms which may be given to the microphone. Many materials, including the ordinary metals, can be used for the electrodes; but it has always been the

practice to make one of them at least of carbon, because this material gives far better results than any other hitherto used. In the Blake transmitter, one electrode is a hemisphere of platinum about $\frac{1}{20}$ of an inch in diameter, slightly flattened, while the other offers a plane surface of hard gas carbon, artificially hardened and polished.

The back electrode, or anvil electrode, as it is sometimes called, is either rigidly held or is more often so mounted that it can yield somewhat, but not too readily, to the motions of the electrode directly acted on by the voice. The desired normal contact and pressure in the latter case are commonly obtained by the use of a spring or by gravity and sometimes in other ways.

A speaking telephone on this principle was described in papers filed in the Patent Office by Mr. Berliner, and by Mr. Edison, in 1887. In 1878, Prof Hughes reinvented it, approaching the problem from a somewhat different direction, viz., from vibrations mechanically excited by scratching with a pencil, or by the tramp of a fly, and passing thence to those excited by sonorous waves in the air. He first published a description of his instrument in a paper read before the Royal Society, London, May 9, 1878. Notices of it are to be found in the *Scientific American* Supplement, June 8, 1878, and elsewhere.

The action of the microphone in transmitting articulate speech is as follows: The sound waves produced by the voice impress their vibrations directly upon the front or "hammer" electrode, and by virtue of the inertia of the back or "anvil" electrode, as already explained, the vibrations of the first electrode cause corresponding variations in pressure between it and the second electrode. These variations of pressure, by varying the electrical resistance of the microphone contact, create electrical undulations in the current similar in form to the sound waves producing them; and when these electrical undulations pass through the coils of the electromagnet of the receiving telephone they cause corresponding variations in the magnetic state of the core, and thus set the diaphragm into vibrations corresponding to such magnetic changes. By these vibrations of the diaphragm air waves are finally produced at the receiving station similar in form to those originally produced by the voice of the speaker at the transmitting station.

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Int. 26. Did you testify as an expert in the case of the American Bell Telephone Company *et al. v.* Albert Spencer *et al.*, in the United States Circuit Court within the District of Massachusetts, wherein a decision has been rendered for the complainants; and were you familiar with the telephonic apparatus therein complained of, and held by the Court to infringe upon the Bell patents aforesaid; if so, what was the character of the transmitting instrument to which the decision in that case applied?

Ans. I did testify as an expert for the complainants in the Spencer case referred to, and became familiar with the telephonic apparatus complained of therein. The transmitter of that apparatus was an articulating microphone, which operated in the manner and according to the method I have described in my last preceding answer.

Int. 27. Did you testify as an expert in the case of the American Bell Telephone Company *v.* Amos E. Dolbear *et al.*, in the United States Circuit Court within the District of Massachusetts, wherein a decision has also been rendered for the complainants; and were you familiar with the telephonic apparatus therein complained of, and held by the Court to infringe upon the Bell patent No. 174,465; if so, what was the character of the transmitting instrument belonging to the apparatus to which the decision in that case applied?

Ans. I testified in the case referred to, and became familiar with the apparatus in that case. The transmitter was an articulating microphone, and it operated in the manner which I have already described.

Int. 28. Did you testify as an expert in the case of American Bell Telephone Company *et al. v.* the People's Telephone Company *et al.*, in the United States Circuit Court, within the Southern District of New York, wherein a decision has also been rendered for the complainants, and were you familiar with the telephonic apparatus therein complained of, and held by the Court to infringe upon the aforesaid patents to Bell? If so, what was the character of the transmitting instrument to which the decision in that case applied?

Ans. I testified as an expert in the case referred to, and was familiar with the apparatus in that case. The transmitting instru-

ment was an articulating microphone, and operated in the manner which I have described.

Int. 29. You have said that the defendants' transmitter produces electrical undulations by utilizing the property of variation in resistance with variation in pressure, possessed by various substances. Please compare the construction and mode of operation of the defendants' transmitter with the construction and mode of operation of the articulating microphone which you have explained, and point out their substantial likenesses and differences.

[*Objected to on the ground that it is irrelevant, because the patent of the complainants is not for an articulating microphone, and therefore the comparison proposed is not material.*]

Ans. The defendants' transmitter is an articulating microphone, whose operation is identical in principle with the operation of the Blake transmitter, the Dolbear transmitter, and the other microphone transmitters to which I have referred. As in the Blake transmitter, the hammer electrode is of platinum, and the anvil electrode of hard carbon. The particular manner in which the anvil carbon electrode is mounted is substantially the same as that patented by Mr. Berliner in 1880, No. 225,790. There is a long adjusting screw which carries the anvil electrode, and by means of which the normal pressure between the two electrodes can be increased until it reaches the amount which is most favorable for good articulation. In the instrument as thus adjusted, the pendulous bar is made to hang somewhat removed from a vertical position, being inclined inwards through a small angle. The platinum hammer electrode consists of a small stud rigidly attached to the centre of a metallic diaphragm. The vibrations impressed upon the diaphragm by the voice produce a variation of pressure between the hammer and anvil electrodes on account of the inertia of the latter, as I have described at length in my answer to Int. 25. The action is identical with that taking place in the various forms of articulating microphone to which I have referred.

It is customary in the practical use of microphone transmitters, to employ an electrical apparatus known as an induction coil, in order to overcome more effectively the resistance of the circuit. An

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induction coil, as so used, consists of two entirely separate coils of wire, having a common axial core of soft iron. One of these coils is wound upon the outside of the other. The inner coil is composed of a small number of turns of rather coarse wire, and is called the primary coil. The outer coil is composed of a large number of turns of fine wire, and is called the secondary coil. The operation of the induction coil is such that, whenever a current of electricity of varying strength is caused to pass through the primary coil, if the ends of the secondary coil are connected with each other (either directly, or indirectly by means of a circuit which may contain a receiving telephone), a current possessing similar variations will flow through the secondary circuit. But in accordance with well-known electrical principles, the current thus generated in the secondary coil will have a far greater power of overcoming resistance than is possessed by the original current in the primary coil. The induction coil thus acts as a sort of electrical lever. In the use of the induction coil with a microphone transmitter, the transmitter with the battery is placed in circuit with the primary coil of the induction coil. The secondary coil is placed in circuit with the line wire and the receiving instrument. Such an induction coil is universally used in the Blake transmitter when employed for commercial purposes, and was present in the transmitter of the defendants in the Spencer case and in the Dolbear case, and in the case against The People's Telephone Company. I find such an induction coil in the Exhibit Defendants' Transmitter.

[*The latter part of the answer relating to the induction coil and other patents also objected to as not responsive to the question.*

Counsel for complainants puts in evidence Letters Patent of the United States, No. 277,198, *dated May* 8, 1883, *and granted to the Overland Telephone Company, as assignee of Myron L. Baxter, for Improvements in Transmitting Telephones, and the same is marked "Exhibit Baxter Transmitter Patent,* C. H. S., *Special Examiner"; also Letters Patent of the United States, No.* 277,199, *dated May* 8, 1883, *and granted to the Overland Telephone Company, as assignee of Myron L. Baxter, for Improvements in Receiving Telephones, and the same is marked "Exhibit Baxter Receiver Patent,* C. H. S., *Special Examiner."*]

Int. 30. Have you examined the specifications of the Exhibit Baxter Transmitter Patent No. 277,198, and of Exhibit Baxter Receiver Patent No. 277,199, and do you understand the construction and mode of operation of the instruments therein respectively described? If so, will you explain the same briefly, and quote from the specifications any descriptive language which you think pertinent to such explanation.

Ans. I have examined the specifications referred to, and understand the construction and mode of operation of the instruments therein described. Referring to the patent No. 277,198, I find it to describe a microphone transmitter. The hammer electrode is a metallic stud attached to the diaphragm, while the anvil electrode is a button of carbon attached to a pendulous iron bar. The instrument also contains an induction coil, the core of which is opposite the lower extremity of the pendulous bar. I find in the specification the following statements: —

"The object of my invention is to provide means whereby the limit of variation in the strength of a voltaic current may be greater than at present. This refers to the undulatory current used for gererating a current for the transmision of speech telephonically, and which, as is well known, is the result of a variation gradual in its nature from strong to weak, and *vice versa*. When the current sent to line is due to magnetic induction from a permanent magnet, the variation to which it owes its existence is effected by strengthening or weakening said magnet; but when said current is derived from a galvanic battery by induction, the variation is produced in the primary or direct battery-current. To the latter class my invention pertains.

"In common with other transmitters I use in mine the vibrating diaphragm carrying or actuating a metallic stud in unstable contact with a piece of hard or soft carbon or carbonaceous material, which is attached to a freely-suspended bar, and an induction-coil for producing the intense induced secondary current; and these, either singly or in combination, in their well-known forms, I do not claim.

"In all the battery-transmitters with which I am acquainted the limit of variation is very narrow, and consequently the strength of the induced current is small.

"My object is, as hereinbefore set forth, to increase the variation (without actually breaking the circuit), and consequently to send to line a much more powerful induced or secondary current to work

upon the distant receiving-telephone, overcoming resistance, leaks, and extraneous induction incident to long lines.

. . . . . .

"E, F, and G represent the induction-coil, which, in addition to its ordinary function, serves, as hereinafter fully described, to vary the pressure between the metal stud *p* and the carbon button *d*.

. . . . . .

"The operation of my invention is as follows: Supposing a given current from the battery to be flowing, the attractive force exerted upon D by E will cause a firm contact between *p* and *d*, which will be approximately the mean of pressure or of surface-contact. If now a heavy impulse thrust forward the stud *p* against *d*, the result will be quite different from that observed when the suspended bar B is held in place merely by gravity or by a spring. Instead of being carried away by its momentum, thus breaking the circuit, the bar C is held in closer contact by the increased attractive force of core E, such increased attractive force being due to a stronger current operating upon it, and such stronger current is obtained by the increased contact between *p* and *d* by the thrust of *p* against *d*. For this reason more ample vibration can be given to the diaphragm without 'breaking.' The pressure, however, at the end of the excursion is considerably less than that quickly succeeding the initial thrust, the then greatly increased attractive force of E having been to a great extent overcome by the momentum of C; but enough force still remains in E to secure, on the retreat of the diaphragm and stud *p*, actual contact."

Referring to patent No. 277,199, I find it to describe one form of magneto receiver. It describes a U-shaped permanent magnet, about one end of which a coil of wire is wound; the other end of the magnet is in contact with a portion of the edge of a vibratory iron diaphragm, the middle point of which is opposite to that pole of the magnet which is surrounded by the coil. The terminals of the coil are connected with screw cups in the ordinary manner. The coil itself is of somewhat peculiar construction, a portion of it being made of iron ribbon. I find the following statements in the specification: The inventor states that he has invented "certain new and useful Improvements in Receiving-Telephones" to which improvements the specification refers. He also says in the specification: "The object of my invention is to provide a more perfect receiving-telephone, and one in which vocal sounds, including speech, shall not only be increased in volume, but also be rendered more clear,

smooth, and natural." Further on, he says: "The features of my invention, which I believe to be new, and which I claim are those belonging, essentially, to the compound actuating-coil, D." A little further on, in describing the effect of the compound coil, he says: "Its effect upon the diaphragm is obvious — it amplifies the vibration."

Int. 31. Please compare the instruments described in the said Baxter patents, with the defendants' instruments, Exhibit Defendants' Transmitter and Exhibit Defendants' Receiver, and state how far they are alike, and how far they differ in respect to any material features; and in this connection you may give your opinion as to the practical effect of what the Baxter transmitter patent calls the "electro-magnetic controlling device."

Ans. The instrument described in the Baxter transmitter patent is essentially the same in almost every detail as the Exhibit Defendants' Transmitter. In both of the instruments the anvil electrode is mounted upon and forms part of a long and rather heavy bar. This is hung from its upper end, and the electrodes are so placed that the bar is or may be by them pushed backward out of the perpendicular, so that its weight tends to keep the electrodes in contact and to give a certain normal pressure. The magnet, which both in the instrument of the patent and in the Exhibit Defendants' Transmitter is placed opposite the lower end of the bar, has for its effect slightly to increase the normal pressure, but without changing the nature of the electrical or mechanical operation of the electrodes. The mass and consequent inertia of the bar are such that a considerable mechanical resistance is offered to the motions which the vibrating diaphragm tends to impress upon it by virtue of the mechanical contact of the one electrode with the other; and thus these motions in the effort of the acting forces to overcome this inertia develop corresponding changes of pressure at the point of contact.

The carbon electrode carried by the suspended bar in the Exhibit Defendants' Transmitter is provided with a relatively longer adjusting screw than that shown in the drawings of the Baxter transmitter patent. By virtue of the greater length of this screw, the suspended

bar can be thrown back farther out of the vertical and into an inclined position. This difference tends to improve the defendants' apparatus, because it more surely secures unbroken contact between the electrodes. Of course, the farther the pendulous bar is thus pushed back, the more its weight is exerted to produce pressure between the electrodes; and it is obvious that the intention of this change is to utilize more effectively the force of gravity in producing the proper normal pressure between the two electrodes. The farther removal of the lower end of this bar from the pole of the electro-magnet diminishes very greatly any effect due to their mutual attraction which the magnet may originally have been intended to exert; and in utilizing the longer adjusting screw in the defendants' instrument it is evidently intended to render the magnet practically inoperative, and to rely upon gravity to give the proper normal pressure between the electrodes.

The electro-magnet, which is provided for exerting an attractive force upon the lower end of the suspended bar in the Exhibit Defendants' Transmitter, also differs from that shown in the drawings of the Baxter patent No. 277,198, in not having a secondary helix to perform the office of an induction coil; but this difference is within the description of the alternative forms of construction contained in the said patent, and does not change the nature of the mechanical operation performed, nor of the electrical changes produced by the movements given to the electrodes by the voice.

This feature of the defendants' transmitter, which is called in the Baxter patent "an electro-magnetic controlling device," is principally characterized by the interposition of the coil in the primary circuit.

The variations in current produced by the voice, and acting through the agency of this electro-magnet upon the suspended bar, cannot, and as I have found by repeated tests and trials of the instrument do not, tend to make the articulating variations in the current which transmits speech different in kind from those produced by other microphones. The effect of this electro-magnet is slight.

The Exhibit Defendants' Receiver and the instrument of the Baxter receiving telephone patent, No. 277,199, are substantially

identical. The hearing tube of the Exhibit Defendants' Receiver is somewhat different in its shape from that of the instrument of the patent, and is almost identical in form with the hearing tube of the ordinary receiving telephone which is used by the licensees of the American Bell Telephone Company.

[*Adjourned.*]

MAY 1, 1885.

Int. 32. Did you testify as an expert in the case of American Bell Telephone Company *et al. v.* The Overland Telephone Company *et al.*, pending in the Circuit Court of the United States, within the Southern District of New York, and are you familiar with the telephone instruments therein complained of as infringements upon the patents to Bell, No. 174,465 and No. 186,787; if so, how do such instruments compare in construction and mode of operation with the defendants' instruments in the present case, Exhibit Defendants' Transmitter and Exhibit Defendants' Receiver, in so far as concerns the telephonic apparatus proper?

Ans. I testified in that case, and became familiar with the telephone instruments therein complained of. The mode of operation both of the transmitter and receiver in the case against the Overland Telephone Company is identical with the mode of operation of the Exhibit Defendants' Transmitter and Exhibit Defendants' Receiver in the present case, in everything essential to the transmission and reproduction of speech. There is no difference worthy of notice between the transmitting instruments in the two cases. The receiving instrument in the Overland Telephone Company case has a cylindrical hearing tube instead of the peculiarly shaped hearing tube which is found in the Exhibit Defendants' Receiver in this case; and it is also furnished with a set screw, by which the permanent magnet of the receiver can be firmly fixed in position. This set screw is absent from the Exhibit Defendants' Receiver in this case, the magnet in it being kept from motion by the use of a cylindrical cap which confines it at the bend of the U. I do not observe any other differences which are worthy of notice.

Int. 33. Please compare Exhibit Defendants' Receiver with the receiving member L of the apparatus specifically described in the patent to Bell, No. 174,465, and shown in Fig. 7 of the drawings

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thereof, and state what differences in construction you find, and how such differences affect, if at all, the substantial likeness of the two instruments in respect to their function and mode of operation, and the work they do in the transmission of sound.

Ans. The operation of the defendants' receiver is identical with the operation of the receiver shown in Fig. 7 of the Bell patent No. 174,465. In the defendants' magneto receiver there is a permanent horseshoe magnet, about one end of which a coil is wound. One end of the horseshoe magnet, therefore, forms the core of the electro-magnet. Instead of the membrane and the attached armature described by Mr. Bell, an iron diaphragm is used, with its centre opposite that pole of the permanent magnet about which the coil is wound. The diaphragm is connected at its edge with the other end of the horseshoe magnet, so that it is permanently polarized by this contact; being in this respect similar in arrangement to the armature shown in the receiver L, of the Bell patent, No. 174,465, which armature is polarized through its connection with the electro-magnet. The permanent magnet used in this instrument replaces the electro-magnet shown in the receiver L, of the Bell patent, which does not affect the substantial likeness of the two instruments, since the function of the battery shown in Fig. 7 is merely to keep the cores of the electro-magnet magnetic. The magnetism of the permanent magnet of the Baxter receiver is substituted for the magnetization produced by the current in the Bell receiver of Fig. 7. The metallic diaphragm of the Baxter receiver replaces the combined armature and membrane diaphragm of the receiver shown in Fig. 7 of the Bell patent No. 174,465. The Baxter receiver contains a peculiar arrangement of the coil, a portion of which is composed of iron wire or ribbon lying between two helices of copper wire. None of these differences, however, in any way affects the substantial likeness between the Baxter receiver and the receiver shown in Fig. 7 of the Bell patent, either in respect to their function or mode of operation, or the work they do in the transmission of sound.

Int. 34. You have in the last preceding answer mentioned the function of the battery shown in Fig. 7 of the patent to Bell, No. 174,465, in respect to the magnetization of the electro-magnet;

will you explain the operation and effect of the transmitting member A of the telephone instrument shown in that Fig. 7, upon the battery current, when such transmitting member is actuated by the vibrations of the air accompanying vocal or other sounds?

Ans. I have already explained the manner in which currents of electricity are produced in a circuit, when an armature like that at *c*, Fig. 7, vibrates to and fro in front of the pole of an electro-magnet. The motion of the armature is capable of producing a current, solely in virtue of the electro-motive force which its motion sets up in the circuit. The magnitude of this electro-motive force depends upon the velocity with which the armature is moving at the moment under consideration, and the direction in which this electro-motive force acts is determined by the direction of motion of the armature, being reversed when the armature changes the direction of its motion. Therefore if there is a battery in the circuit, the total current in the circuit at any given instant will be that due to the algebraic sum of the electro-motive force of the battery, which we may assume to be constant, and the electro-motive force produced in the circuit at the instant considered, by the motion of the armature, which last electro-motive force, as I have said, is dependent upon the velocity of the armature at the instant considered. When the electro-motive force due to the motion of the armature coincides in direction with the electro-motive force due to the battery, this last electro-motive force is evidently strengthened by the addition; and hence the total current flowing in the circuit is correspondingly increased; that is, the battery current is strengthened by an amount equal to that of the current which the vibrating armature alone would produce in the circuit if the battery were removed and the cores of the electro-magnet magnetized in some other manner. If the electro-motive force due to the motion of the armature is opposite in direction to that due to the battery, the current will be weakened. Hence, as the armature moves to and fro, every change in the direction or velocity of its motion will produce a corresponding change in the strength of the current flowing in the circuit.

Int. 35. Will you refer to the second Bell patent, No. 186,787,

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which has been produced in evidence, and describe briefly so much of the apparatus therein described as is referred to in the third, fifth, sixth, seventh and eighth claims, pointing out the functions or results which are attributed to the parts of the apparatus referred to in those claims?

Ans. Claim 3 is as follows: —

"3. The combination with an electro-magnet, of a plate of iron or steel, or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air or by the attraction of a magnet."

By this, I understand an electro-magnet combined with a plate of iron, steel or other material capable of inductive action.

To satisfy the conditions of this claim, the plate must be of such material, size, thickness and elasticity, and must be so mounted and arranged with reference to the magnet, that on the one hand the delicate air vibrations characterizing articulate speech may be able to impart their vibration to it without substantial alteration in character; while on the other hand, it is capable of being set into vibration through the action upon it of the minute changes imparted to the magnet by the variations in the current passing through the coil surrounding it, when those variations are of the delicate character which are employed in the transmission of speech in the speaking telephone.

Claim 5 is as follows: —

"5. The formation, in an electric telephone such as herein shown and described, of a magnet with a coil upon the end or ends of the magnet nearest the plate."

This claim relates to the special form of magnet suited for use in an electric telephone, the coil being placed about the end or ends of the magnet nearest the plate. The object of thus placing the coil is to render the magnet quicker in its working; that is, more ready to respond with the requisite rapidity to the variations in the strength of the current passing through the coil. A magnet with the coil thus placed responds more quickly by changes in its strength to slight changes in the strength of the current, and hence it is better adapted for use in the speaking telephone than a magnet in which

the coil surrounds the whole length of the magnet, and which consequently acts more slowly.

Claim 6 is as follows: —

"6. The combination, with an electric telephone such as described, of a sounding-box, substantially as herein shown and set forth."

In this claim is mentioned the sounding box, which is combined with the telephone. This sounding box has an important influence in screening the plate of the instrument from the effect of extraneous sounds. The thin air space in front of the plate also exercises an important influence.

Claim 7 is as follows: —

"7. In combination with an electric telephone, as herein described, the employment of a speaking or hearing tube for conveying sounds to or from the telephone, substantially as set forth."

The speaking or hearing tube mentioned in this claim serves to concentrate the sounds produced by the voice upon the diaphragm when used as a transmitter, or to convey to the ear the sounds produced by the diaphragm when used as a receiver.

Claim 8 is as follows: —

"8. In a system of electric telephony, the combination of a permanent magnet with a plate of iron or steel, or other material capable of inductive action, with coils upon the end or ends of said magnet nearest the plate, substantially as set forth."

In this claim I find mentioned the combination of a permanent magnet with coils upon its end or ends, as described, with a plate of iron, or other material capable of inductive action. The use of the plate of iron, in connection with the magnet, as described, in a system of electric telephony, furnishes a most excellent method of causing the electrical and magnetic variations of the apparatus to produce corresponding vibrations in the air.

Int. 36. Referring to the defendants' instruments which have been introduced in evidence, will you compare them with the apparatus described in the patent last referred to, and state how far, if at all, you find them to embrace the features or combinations described in that patent, and referred to in the claims above specified?

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Ans. In the Exhibit Defendants' Receiver I find a magnet combined with a plate in the manner described in claim 3. I also find that this magnet has a coil upon the end which is nearest the plate, as described in claim 5; I find also a permanent magnet, as described in claim 8. The magnet in Exhibit Defendants' Receiver and the microphone in Exhibit Defendants' Transmitter are placed within a sounding box, as described in claim 6. Both Exhibit Defendants' Transmitter and Exhibit Defendants' Receiver possess the speaking and hearing tube mentioned in claim 7. In the Exhibit Defendants' Transmitter and the Exhibit Defendants' Receiver the hearing or speaking tube is so arranged as to leave a thin space filled with air in front of the vibrating plate.

There are certain minor and unimportant differences between the defendants' receiver and the specific forms of receiver figured and particularly described in the said Bell patent, No. 186,787. The metallic diaphragm of the defendants' instrument is in contact at one point of its edge with that pole of the horseshoe magnet which is not surrounded by the coil. This arrangement is not new with the defendants, nor is it stated to be new in the Baxter patent. Substantially such an arrangement of diaphragm and magnet is found in Alexander Graham Bell's patent, No. 201,488, dated March 19, 1878.

Another peculiarity of the defendants' receiver is, that in addition to the coil upon the end of the magnet, it contains an iron strip or ribbon coiled around the first helix of copper wire, with the separate whorls insulated from each other. Outside of this is another coil of copper wire, and the two coils of copper wire are electrically connected in series. The coiled ribbon is used as the conductor to connect them. This arrangement constitutes the ribbon a sort of tubular electro-magnet, and the structure belongs to that class of compound electro-magnets, of which those described by Du Moncel in his "Exposé des applications de l'électricité," Vol. V. pp. 349–351, Fig. 96 and Fig. 97, published in 1878, are examples. These had been previously described in "Comptes Rendus," Vol. LXXX., January–June, 1875, pp. 532, 1572, and Vol. LXXXI., July–December, 1875, p. 17. Such a construction, however, is not so advantageous for the purposes of a magneto-

telephone as the simple coil of the instrument described in Bell's patent No. 186,787, and embodied in his hand telephone which is in common use. While the iron ribbon in the coil of the defendants' receiver may give to the instrument a somewhat greater absolute magnetic strength, it makes the action of the receiver more sluggish than if the ribbon were absent, and impairs its sensitivity under the rapid changes used and required for the reproduction of articulate speech.

All these differences, however, between the defendants' receiver and the magneto-telephone described and set forth in the Bell patent, No. 186,787, are merely differences of form or of minor details of construction, and do not affect the essential features which constitute the defendants' instrument substantially the same as that described in the said Bell patent, and referred to in the third, fifth, sixth, seventh and eighth claims thereof.

Int. 37. I find in the second Bell patent a statement that the same instrument is used both as transmitter and receiver, and I understand that the electrical and magnetic portions of the apparatus described in Bell's first patent are the same both in the transmitter and receiver, the instruments differing merely in the forms of the cones, one of which is especially adapted to enclose the mouth, while the other is shaped so as to enter or be applied to the ear; will you state whether the magneto-telephone Exhibit Defendants' Receiver is, when properly connected in line with another instrument of the same kind, capable of being used as a transmitter as well as a receiver?

Ans. It is capable of being used both as transmitter and receiver under the circumstances mentioned.

Int. 38. Will you describe the character of the circuits and connections indicated by the structure of the defendants' two instruments, and usual with a speaking telephone apparatus which includes a battery transmitter, and then state whether the magneto-instruments, as arranged at the two ends of the line, will be so connected in circuit with each other that, without any change, speech uttered into one will be heard at the other?

Ans. I make the following drawing to illustrate my meaning: —

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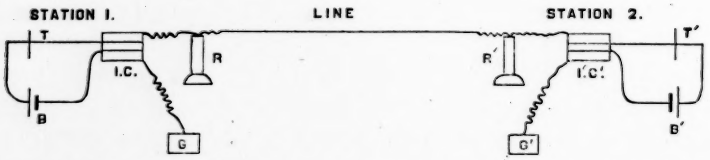

In the figure, I C and I′ C′ are two induction coils; B and B′ are voltaic batteries, and T and T′ transmitters in the primary circuits of the coils. R and R′ are magneto-telephones placed in a line connected with one terminal of the secondary wire of each induction coil. G and G′ are earth plates, with connecting wires running to the other terminals of the secondary wires of the induction coils. G and G′ are buried in the earth, so that the secondary circuit is completed through the earth, and includes the secondary helices of the two induction coils, and the two magneto-telephones R and R′. Speech actuating either T or T′ is reproduced in the receivers R and R′. Also, if either R or R′ be spoken into and used as a transmitter, since R and R′ are joined in complete circuit by means of the line wire, the secondary wires of the coils, and the earth, speech will be reproduced in the other receiver, as when the apparatus shown in Fig. 7 of the first Bell patent, or Figs. 4 and 6 of the second Bell patent, is used.

This is the ordinary arrangement, and, as indicated by the construction of the defendants' transmitter, is the arrangement intended to be used by them. Indeed, it is not uncommon on ordinary telephone lines, as thus arranged, to use one of the magneto-instruments as a transmitter, when for any cause the microphone transmitter, the battery, or any portion of the primary circuit is out of order.

Int. 39. I understand from your previous testimony, that in a speaking telephone apparatus consisting of transmitters, receivers, batteries and other adjuncts, as shown in the above diagram, the articulate speech uttered into any transmitter is heard at the receiver as the same articulate speech in consequence of the electrical undulations similar in form to the sound waves, and that those electrical undulations are caused by the utterances of the speaker, which said sound waves are due to or accompany. I wish you would now state, by reference to said diagram, in what part of the whole apparatus, including in that phrase the various circuits, those electrical undula-

tions exist, and in what part they must exist and be operative, in order that speech may be transmitted so as to be intelligible to the listener.

Ans. If a person speaks into one of the transmitters, as, for example, T at station 1, the current produced in the primary circuit by the battery B is thrown into the described electrical undulations by the action of the voice upon the transmitter. These undulations occur throughout the whole primary circuit of the induction coil I C. Similar electrical undulations are produced in the secondary of I C, and in the whole circuit of which it forms a part, including the magneto-telephones R and R′, and the secondary wire of the induction coil I′ C′. Similar undulations are also produced in the primary of the induction coil I′ C′; but in this circuit they have no importance. These electrical undulations are produced in the primary circuit by the action of the voice upon the transmitter. It follows, from the relation of the primary and secondary helices of the induction coil, that undulations similar in form are produced in the secondary wire, the line, and the receiving instruments placed in the circuit. It is because of the presence of these electrical undulations in the secondary circuit, and of their similarity to the undulations produced by the voice in the primary circuit, that words spoken into the transmitter are reproduced by the receiver.

Cross Examination by A. V. BRIESEN, Esq., *of Counsel for Defendants.*

Cross-Int. 40. Is the fact to which you refer in answer to Int. 37, namely, that the defendants' magneto-telephone receiver is capable of being used as a transmitter as well as a receiver, in your opinion important for the comparison of said receiver with the Bell patent of 1876?

Ans. So far as the Bell patent of 1876 is concerned, my reason for stating the fact in making the comparison was that it seemed to show more clearly the relations existing between the defendants' magneto-telephone receiver and the apparatus of the said Bell patent. It seemed to me that the fact in question was for this reason sufficiently important to have attention called to it.

Cross-Int. 41. Will you please state upon what theory a mag-

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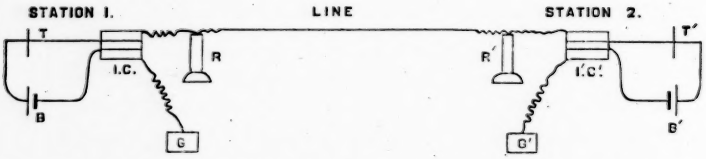

In the figure, I C and I′ C′ are two induction coils; B and B′ are voltaic batteries, and T and T′ transmitters in the primary circuits of the coils. R and R′ are magneto-telephones placed in a line connected with one terminal of the secondary wire of each induction coil. G and G′ are earth plates, with connecting wires running to the other terminals of the secondary wires of the induction coils. G and G′ are buried in the earth, so that the secondary circuit is completed through the earth, and includes the secondary helices of the two induction coils, and the two magneto-telephones R and R′. Speech actuating either T or T′ is reproduced in the receivers R and R′. Also, if either R or R′ be spoken into and used as a transmitter, since R and R′ are joined in complete circuit by means of the line wire, the secondary wires of the coils, and the earth, speech will be reproduced in the other receiver, as when the apparatus shown in Fig. 7 of the first Bell patent, or Figs. 4 and 6 of the second Bell patent, is used.

This is the ordinary arrangement, and, as indicated by the construction of the defendants' transmitter, is the arrangement intended to be used by them. Indeed, it is not uncommon on ordinary telephone lines, as thus arranged, to use one of the magneto-instruments as a transmitter, when for any cause the microphone transmitter, the battery, or any portion of the primary circuit is out of order.

Int. 39. I understand from your previous testimony, that in a speaking telephone apparatus consisting of transmitters, receivers, batteries and other adjuncts, as shown in the above diagram, the articulate speech uttered into any transmitter is heard at the receiver as the same articulate speech in consequence of the electrical undulations similar in form to the sound waves, and that those electrical undulations are caused by the utterances of the speaker, which said sound waves are due to or accompany. I wish you would now state, by reference to said diagram, in what part of the whole apparatus, including in that phrase the various circuits, those electrical undula-

tions exist, and in what part they must exist and be operative, in order that speech may be transmitted so as to be intelligible to the listener.

Ans. If a person speaks into one of the transmitters, as, for example, T at station 1, the current produced in the primary circuit by the battery B is thrown into the described electrical undulations by the action of the voice upon the transmitter. These undulations occur throughout the whole primary circuit of the induction coil I C. Similar electrical undulations are produced in the secondary of I C, and in the whole circuit of which it forms a part, including the magneto-telephones R and R′, and the secondary wire of the induction coil I′ C′. Similar undulations are also produced in the primary of the induction coil I′ C′; but in this circuit they have no importance. These electrical undulations are produced in the primary circuit by the action of the voice upon the transmitter. It follows, from the relation of the primary and secondary helices of the induction coil, that undulations similar in form are produced in the secondary wire, the line, and the receiving instruments placed in the circuit. It is because of the presence of these electrical undulations in the secondary circuit, and of their similarity to the undulations produced by the voice in the primary circuit, that words spoken into the transmitter are reproduced by the receiver.

Cross Examination by A. V. BRIESEN, Esq., *of Counsel for Defendants.*

Cross-Int. 40. Is the fact to which you refer in answer to Int. 37, namely, that the defendants' magneto-telephone receiver is capable of being used as a transmitter as well as a receiver, in your opinion important for the comparison of said receiver with the Bell patent of 1876?

Ans. So far as the Bell patent of 1876 is concerned, my reason for stating the fact in making the comparison was that it seemed to show more clearly the relations existing between the defendants' magneto-telephone receiver and the apparatus of the said Bell patent. It seemed to me that the fact in question was for this reason sufficiently important to have attention called to it.

Cross-Int. 41. Will you please state upon what theory a mag-

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neto-telephone receiver, which is capable of being used both as transmitter and as receiver, is related to the Bell patent of 1876.

Ans. As a matter of fact, so far as the electrically active parts of the transmitter and receiver of the Bell patent of 1876 are concerned, the instrument serving as a receiver will also serve as a transmitter, and conversely.

Cross-Int. 42. Then do you desire to be understood as testifying that such an electro-magnetic receiver, so capable of serving as a transmitter, is covered by the Bell patent of 1876?

Ans. The only particular electro-magnetic receiving instrument, regarding which I have testified in this case, is Exhibit Defendants' Receiver. As this instrument is intended to be operated, this receiver certainly employs the method described in the fifth claim of that patent.

Cross-Int. 43. You will note that in Cross-Int. 40 and Cross-Int. 41, the term "capable" was used in connection with the double use of the receiver, and you answered those questions in that sense. Will you let your answer to Cross-Int. 42 stand, if for the word "intended" the word "capable" was substituted?

Ans. If I were to use the word "capable," I should frame my sentence in a somewhat different manner. I replied as I did, lest I should seem to be expressing an opinion on what appeared to me to be simply a question of law. The Exhibit Defendants' Receiver is certainly capable of transmitting speech by means of the method described in the fifth claim of the first Bell patent.

Cross-Int. 44. If you were shown that receiver only, without knowing how the maker intended it to be used, and found it capable of serving both as transmitter and as receiver, would you regard it as covered by the fifth claim of Bell's first patent?

Ans. It seems to me that your question involves a knowledge of matters which, as an expert alone, I can hardly be expected to understand. If I saw such an instrument, I should, of course, from its appearance and construction, suppose that it was intended to be used as a magneto transmitter or receiver for the transmission or reproduction of articulate speech, and that in its operation the method described in the fifth claim of the Bell patent, No. 174,465, would be employed.

Cross-Int. 45. Will you please answer the preceding cross-questions, with reference to the Bell patent of 1877, here in suit?

Ans. In answer to Cross-Int. 40, I think that the capability of the Exhibit Defendants' Receiver to be used as a transmitter as well as a receiver, is sufficiently important to have attention called to it in comparing it with the Bell patent of 1877.

In answer to Cross-Int. 41, the instrument of the second Bell patent is capable of serving both as transmitter and as receiver.

In answer to Cross-Int. 42, the Exhibit Defendants' Receiver is in various points, as I have already pointed out, substantially identical with the instrument described in the Bell patent of 1877.

In answer to Cross-Int. 43 — Cross-Int. 43 would not apply to my last answer.

Cross-Int. 44 seems to me to involve matters of law which I am not expected to understand. If such an instrument were given me, and I were forced to draw my own inferences as to its use from its appearance, I should suppose it to be a telephone containing such elements as are described, and intended to be operated as explained in the Bell patent of 1877.

Cross-Int. 46. Does the Exhibit Defendants' Receiver, now handed you, embody the invention described in Bell's patent of 1876?

Ans. It, of course, does not separately as a receiver, that is, as an instrument, embody the method which is described in the fifth claim of that patent; but if it is connected up with another similar instrument or with a microphone transmitter, to be used in the ordinary manner for the transmission of speech, it does employ that method, and the apparatus, as a whole, would embody the invention described in the Bell patent of 1876. Whether it is or is not an apparatus for transmitting sounds telegraphically, according to the method described in that patent, will depend upon the use to which it is to be put.

Cross-Int. 47. Then the mere fact that it is capable of such use as will bring it within the specification of Bell's patent does not induce you to testify that, in your opinion, it embodies the invention which is described in that patent. Am I right?

Ans. If I understand your question, you ask me substantially whether the fact that the defendants' receiver can be so used as to

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employ the method of transmitting vocal or other sounds telegraphically, as described by Mr. Bell in his first patent, necessarily makes it, whatever it may have been constructed for, and however it may be intended to be used, an instrument which employs that method. In my opinion, it does not.

Cross-Int. 48. When first did you devote yourself to the investigation of the telephone?

Ans. I first became acquainted with the Reis telephone, if I recollect rightly, in 1867 or 1868, when a student; and have been interested in telephonic apparatus ever since.

Cross-Int. 49. How came you to learn of the Reis telephone?

Ans. I do not now recollect whether it was described in lectures on physics which I attended, or whether I first read the description in Koenig's catalogue, or some other book.

Cross-Int. 50. When first did you make or assist in making a telephone?

Ans. If you mean by this the constructing or helping in the actual construction of an apparatus, as distinct from operating an apparatus already constructed, I do not remember doing anything of the kind until, I think, the early part of 1872.

Cross-Int. 51. Before 1872, did you take part in any experiments relating to the telephone; if so, what were the experiments?

Ans. I have a strong impression that previous to that time I operated an apparatus constructed by Koenig, and resembling in certain respects a Reis receiver, with a vibrating tuning fork.

Cross-Int. 52. In your cross examination in the Spencer case (Cross-Int. 66), you speak of an apparatus that had been used previous to 1872 by Prof. Pickering. What do you know about that apparatus, and what was your relation at that time to Prof. Pickering?

Ans. I was at that time either a student with him, or an instructor in the same department; I don't remember which, because I don't remember the exact date of the experiments. I was not myself present on the afternoon in which he performed the experiments in question.

Cross-Int. 53. Did you see and make use of his apparatus?

Ans. I saw a portion of the apparatus; I did not make use of

it. As far as I know, it was never afterwards used for that purpose.

Cross-Int. 54. When did you first lecture on the telephone, and where?

Ans. I suppose that the first time that I ever described a telephone in a lecture was in 1870 or 1871, to one of my first classes in physics after I became an instructor at the Institute; but I cannot tell exactly, without referring to my notes.

Cross-Int. 55. What instruments, if any, did you then use?

Ans. I do not remember, and doubt very much if I used any instruments. I think very likely that I may have described the sonometer which Professor Pickering used as a transmitter in the experiments which I have referred to.

[*All after the word "instruments" objected to.*]

Cross-Int. 56. When did you first use a telephone in your lectures?

Ans. The first distinct remembrance that I have of showing anything, except a form of Reis receiver, was in the early part of 1872.

Cross-Int. 57. What kind of an instrument was that?

Ans. I used for a transmitter an ordinary tuning fork circuit-breaker; and for a receiving instrument, the bottom of a very large tin box, which was placed opposite an electro-magnet included in circuit with the transmitter and a battery.

Cross-Int. 58. Did you transmit sound by that instrument in 1872?

Ans. I transmitted the pitch of, I think, two different tuning forks, separately in different experiments.

Cross-Int. 59. [*Question repeated.*]

Ans. I entirely fail to see why I have not fully and completely, though briefly, answered the question already. What I meant to have understood was simply this: that when the tuning fork vibrated, thereby making and breaking the circuit and so alternately magnetizing and demagnetizing the electro-magnet, the diaphragm was caused to move toward and away from the electro-magnet once for each complete vibration of the tuning fork. This caused

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a sound to issue from the receiver identical in pitch with the sound produced by the fork itself, but not identical either in quality or in amplitude with the vibration of the fork; that is, the sound issuing from the receiver had the same pitch as that of the sound produced by the vibrating tuning fork. This is what I meant by the transmission of the pitch, and in this sense I transmitted sound by that instrument.

Cross-Int. 60. Do you remember what tuning forks you used in that experiment, and the number of their vibrations?

Ans. I am not quite certain at this moment, but I think that one of them gave one hundred and twenty-eight double vibrations per second.

Cross-Int. 61. Do you remember the size or proportions of the electro-magnet you used in that instrument?

Ans. The electro-magnet is still in existence. It is a horseshoe magnet with its legs about five or six inches in length and about an inch in diameter. The wire surrounding it is wound on separate spools and is quite coarse.

Cross-Int. 62. Do you wish to be understood as testifying that that magnet was, or could be, demagnetized and magnetized in intervals of one hundred and twenty-eighth parts of a second?

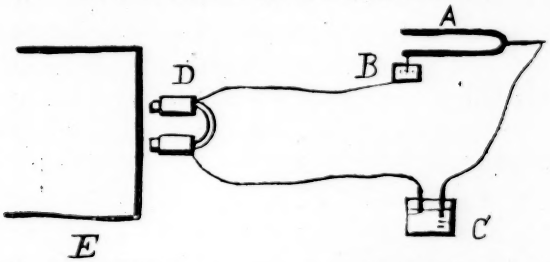
Ans. I have used the terms "magnetized" and "demagnetized" in the general sense in which it is very common to employ them in describing phenomena of this character. The magnet in question has a core of quite soft iron, but my impression regarding it is that it has a slight amount of residual magnetism. This would, of course, prevent absolute demagnetization in so short a time; but this is in no way material to the operation which I have described it as producing upon the soft iron plate.

Cross-Int. 63. Please look at the sketch I now show you, and say whether it correctly represents the instrument which you used at that lecture in 1872.

Ans. It does in all essential points. I think that we used several cells of battery.

[*Counsel for defendants offers the said sketch in evidence, and the same is marked "Defendants' Exhibit Professor Cross '72 Lecture Instrument, C. H. S., Special Examiner."*]

DEFENDANTS' EXHIBIT PROFESSOR CROSS' '72 LECTURE INSTRUMENT, C. H. S. Sp'l Ex'r.



A TUNING FORK. **B** MERCURY CUP.
C BATTERY. **D** ELECTRO-MAGNET.
E BOTTOM OF TIN BOX.

Cross-Int. 64. When you used the tuning fork in that instrument, it made and broke the current one hundred and twenty-eight times a second; is that it?

Ans. It is.

Cross-Int. 65. Did you observe a spark above the mercury at each break of the circuit?

Ans. I observed in all of these experiments, so far as I remember, the seemingly continuous sparks which such a circuit-breaker gives; but I ordinarily adjusted the apparatus so that I could hear the sound of the sparks.

Cross-Int. 66. And you testify here that an electric circuit is broken whenever a spark appears in it. Is that your opinion as an expert?

Ans. If you will indicate the particular statement to which you refer in your question, I can answer it with less liability of being misunderstood than I can the question as it stands.

Cross-Int. 67. I refer to your last previous answer, and understood you there to testify that the sparks were proof of a broken circuit, for you mention "sparks which such a circuit-breaker gives"; with this explanation, I repeat Cross-Int. 66.

Ans. It does not seem to me that your broad inference from that statement is a legitimate one. In the experiment which I was describing, I adjusted the circuit-breaker so as to produce what were then and are still ordinarily called "makes and breaks of the circuit." I did not intend to make any general statement as to what might be inferred from the appearance of a spark; but no fact is

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better known than that with a suitable current, such for example as is used in electric lighting, you can bring two terminals together and separate them, thereby producing what will be a sort of spark on a large scale, if you carry the separation to a very considerable extent; but which if you do not separate them too far, will remain permanent as a voltaic arc, the current continuing to flow from one terminal to the other.

[*Adjourned.*]

MAY 2, 1885.

Cross-Int. 68. When you mention "breaks of the circuit" in your last previous answer, what do you mean?

Ans. By makes and breaks of the circuit, as I used the term in my last answer, I mean that the solid contact point and the mercury in the cup beneath it ceased to be in contact when the circuit was broken, while that contact was renewed when the circuit was again made.

Cross-Int. 69. Then you meant make and break of contact, and not make and break of circuit; or are these terms synonymous, in your opinion?

Ans. The term "breaking of the circuit" has, I think, been used in different senses, sometimes as meaning a breaking of the continuity of the solid or liquid portions of the circuit, even though, as in the case of the electric arc, which I have previously referred to, the current may continue to flow, but more commonly as synonymous with a breaking of the current. It was in this last sense that I used the term in my answer, and it is in this sense that the term "circuit-breaker" has universally been used.

Cross-Int. 70. Are you prepared to inform us whether or not the current of electricity in the instrument you exhibited at the 1872 lecture was actually interrupted at each upward movement of the lower prong of the fork?

Ans. In my opinion, it was.

Cross-Int. 71. Are you prepared to inform us whether or not in the instrument you exhibited at the 1872 lecture, a spark was actually created at each upward movement of the lower prong of the fork?

Ans. If you mean by your question to ask me if never in the course of those experiments the tuning fork vibrated with so small

an amplitude of vibration as not to lift the metal contact piece out of the mercury, my reply is, that I have no doubt that this frequently occurred. In fact, in these earliest experiments, I did not use an electro-magnet to keep the fork in continuous vibration, but merely struck the end of the fork with my finger, or some other soft object, so as to set it into vibration, and then allowed it to vibrate freely until it came to rest. Of course, I do not recollect at this date whether, in these specific experiments, I, each time that I used the fork, adjusted its position so that when at rest the end of the style attached to it touched the surface of the mercury; but it has always been my custom to adjust such vibrating-fork circuit-breakers so that when at rest the solid contact point should dip very slightly below the surface of the mercury, and, for this reason, I suppose that I used the same adjustment then. In this case, when the vibrations of the tuning fork became slight, the circuit would not actually be made and broken at each vibration, nor would sparks occur at that time.

If, on the other hand, you mean to inquire if, in my opinion, during the normal operation of the apparatus, when it was transmitting pitch, sparks were produced substantially at each vibration of the fork, my answer is, that I presume they were.

Cross-Int. 72. And because the sparks appeared in such normal operation, do you say that the current of electricity in that instrument was broken?

Ans. That is one reason for my holding this opinion.

Cross-Int. 73. Do you desire us to understand that in that instrument, whenever there was a spark there was an absolute interruption of the current, or a mere diminution of its strength? I refer to the instrument which, as you stated in your answer to Cross-Int. 63, had a battery of several cells.

Ans My belief is, that in that particular experiment there was an absolute break of current whenever the spark occurred.

Cross-Int. 74. Is not the spark in such an instrument proof of the simultaneous existence of an electric current?

Ans. If you will define to me the exact sense in which you use the term "electric current," I can answer your question more precisely.

Cross-Int. 75. Can't you answer it without further definition on my part? You have already testified that in that instrument whenever there was a spark there was an absolute break of current, and it seems to me, therefore, that my question, which repeats the terms of your previous answer, requires no further definition.

Ans. The question was not and is not clear to me as it stands, because from the way in which it is stated, I think, that a direct and broad reply might seem to give countenance to a not uncommon misuse of the term "electrical current." I will endeavor, however, to answer it, understanding that the term "electric current" is used in the sense in which I have used it myself throughout this deposition. In such a circuit-breaking apparatus as I have described, a spark occurs on separating the contact pieces, and does not occur until the current begins to fall off very rapidly. The current is reduced to zero in a very brief period of time. The spark also lasts only during an excessively brief period of time. Whether the current absolutely ceases throughout the whole circuit a very brief interval of time before or a very brief interval of time after the spark has disappeared, would perhaps in extreme cases depend upon the conditions of the circuit; the complete action in the case of the apparatus which I used being very complicated, and involving many considerations which have not been touched upon in this deposition.

Cross-Int. 76. At a later lecture you employed an electro-magnet for the purpose of keeping the tuning fork in vibration; is that correct?

Ans. It is.

Cross-Int. 77. Please state when that was.

Ans. It was in the early winter of 1873–4; if I recollect rightly, in December, 1873, though I cannot give the exact date without looking up my notes.

Cross-Int. 78. Where did you deliver these lectures, and about how frequently?

Ans. The lectures were delivered in the lecture room at that time belonging to the Physical Department of the Institute of Technology, in what is now called the Rogers Building. I have a distinct recollection only of having shown the apparatus in operation

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at two lectures, the first before the New England Conservatory of Music; the second in a Lowell free course of eighteen lectures on acoustics, at the Institute. I also showed the apparatus to my classes occasionally, but do not remember that I set it in operation for them.

Cross-Int. 79. Can you name any persons who were present at these lectures?

Ans. Prof. Tourjée of the New England Conservatory of Music, was present at the first; and it is my impression that Prof. E. C. Pickering, now of Harvard University, was also present. I cannot speak certainly with regard to the presence of any particular person at the other lectures.

Cross-Int. 80. Was Mr. A. G. Bell, the patentee, present at any of them?

Ans. So far as I am aware, Mr. Bell was not present at any lecture at which I exhibited this instrument.

Cross-Int. 81. And do you mean to testify that he did not see the instrument, to your knowledge?

Ans. I have made no such statement.

Cross-Int. 82. When did he first see it, to your knowledge?

Ans. I cannot state these details exactly as to time, but will reply as definitely as I can. I recollect talking with Mr. Bell, not knowing then who he was, at the close of one of my Lowell lectures, probably in January, or perhaps in February, 1874. As far as I can recollect, my conversation that afternoon related solely to the readiness with which a harmonic series of tuning forks could be kept in vibration by a single governing circuit-breaking fork. I do not recollect showing Mr. Bell any apparatus, and have no distinct recollection of any subsequent conversation with him until the spring of 1874, I think some time in March, when he delivered a lecture on visible speech before the Society of Arts, at the Institute. Very soon after this he called to see me at the Institute, and I showed him some of our acoustic apparatus, including the interrupting tuning forks and our set of Helmholtz's resonators. I do not recollect showing him the magnet and box at that time, but I met him very frequently during the remaining weeks, and he probably first saw the box then. I never showed him the apparatus in operation.

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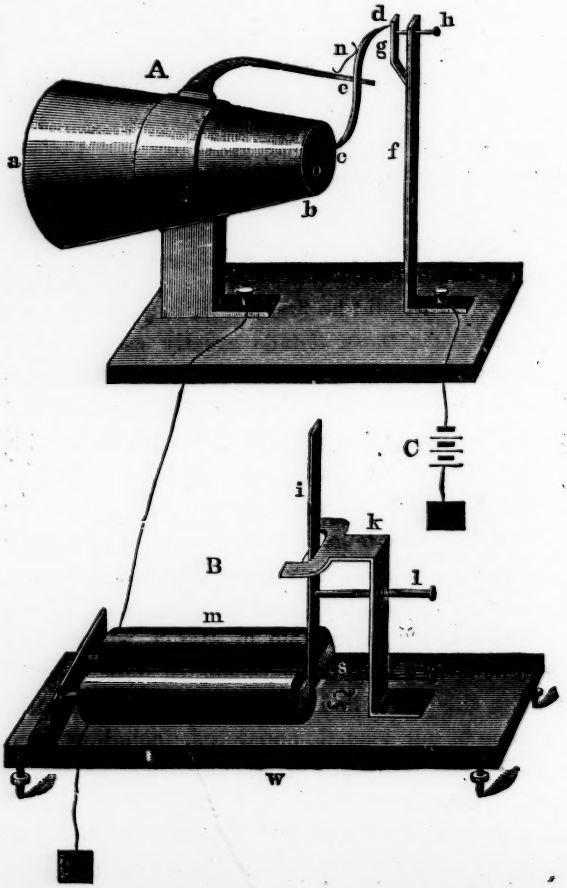
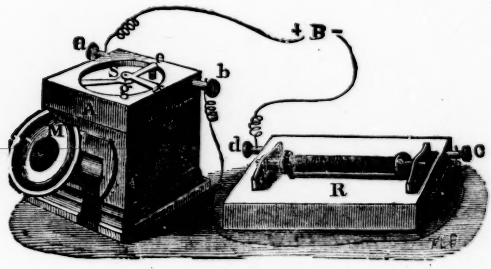
Cross-Int. 83. You have referred in your direct examination to the Reis transmitting instrument. Have you performed any experiments with the Reis transmitters and Reis receivers?

Ans. I have.

Cross-Int. 84. What forms of Reis instruments have you experimented with? If any of them are described or illustrated in Prescott's work on the speaking telephone, please point them out.

Ans. I have used, amongst others, the Reis receiver figured on p. 13 of the book mentioned, edition of 1879, and also the apparatus shown on p 10.





Cross-Int. 85. At the time you used the Reis instrument, shown on p. 10 of Prescott's work, did you or not observe sparks at the point *d* whenever the current was interrupted?

Ans. I do not recollect what observations of this kind I made with that instrument.

Cross-Int. 86. If the said Reis instrument is used as specified in Legat's description, as printed on pp. 197–204 of the Spencer record, would or not a spark necessarily appear at the point *d* of the transmitting instrument whenever the circuit is broken?

Ans. I should expect to see such sparks produced.

Cross-Int. 87. In the Spencer record, did you or not testify as follows: —

" *Cross-Int.* 57. Suppose a Reis transmitter of the form shown on page 10 or page 13 of said Prescott's work is spoken into so softly as not to cause any actual separation of the electrodes; will not such transmitter act so as to vary the electric current, so as to produce in such current an undulation corresponding in form to the sound spoken into such transmitter?

" *Ans.* When operated in the manner described, the transmitter figured on page 10 will do this.

" *Cross-Int.* 58. In your opinion, will the efficiency of the Reis transmitter vary with the kind of material which is used for the electrodes?

"*Ans.* For use as a Reis transmitter, the efficiency is doubtless much influenced by the nature of the electrodes, which is well known to be the case in all circuit breakers.

"*Cross-Int.* 59. Suppose a Reis transmitter of the form shown on p. 10 of Prescott's work is spoken into so softly as not to cause any actual separation of the electrodes; will not such transmitter produce in the electric current in the line wire, a series of undulations corresponding to the 'quality' of the sounds spoken into such trans-

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mitter? I use the term 'quality' in the sense in which you have used it in speaking of the characteristics of sound vibrations.

"*Ans.* It will."

Ans. I testified in the language which you have quoted; with my present knowledge, I should slightly modify my language, as since I gave that deposition I have studied these phenomena to a much greater extent than I had been able to do at that time.

[*All after the word "quoted" objected to as not responsive.*]

Cross-Int. 88. Do you know of any reports of your lectures to which you have testified, or have you any notes of them which you can produce?

[*Objected to as inadmissible, because relating to subject matter not opened in the direct examination, and as immaterial and irrelevant.*]

Ans. I think that a report was published of my first lecture in 1872, but do not think that any was published of the second lecture. I have my notes of both lectures, though I do not recollect distinctly what is in them. They are merely headings to remind me of the order of the topics I wished to discuss. I can produce them, if desired.

Cross-Int. 89. Did you, in using the Exhibit Defendants' Transmitter, ever observe sparks between the electrodes?

Ans. I cannot say without referring to my notes, whether I did or did not; but do not recollect having observed them with this instrument.

Cross-Int. 90. What battery power did you use in connection with it?

Ans. If I recollect rightly, I used one Leclanché cell.

Cross-Int. 91. Are the carbon and platinum contact pieces of that defendants' transmitter, in your opinion, the equivalent of the mercury and wire conductor that are referred to in complainants' patent of 1876, and in your quotation therefrom in answer to Int. 16?

Ans. Considered simply as a means of producing electrical undulations, it seems to me that they are.

Cross-Int. 92. Is carbon capable of inductive action when placed in an electric circuit, in the sense in which you found metal opposite an electro-magnet capable of inductive action?

Ans. I do not understand what experiment of mine is referred to in the question.

[*It is agreed by and between counsel for the respective parties that when the cross examination of this witness is suspended to-day, May 2, 1885, it is adjourned to Monday, May 25, 1885, or to the earliest day in that week which the engagements of the witness may permit.*]

Cross-Int. 93. I refer you to your answer to Int. 35.

Ans. As I understand the question now, I am asked whether carbon is a material capable of inductive action, in the sense in which that term is used in my reference to claim 3 of the Bell patent of 1877. I suppose that, strictly speaking, any substance which is in any way affected by a magnet, would in this sense be capable of inductive action, and carbon is thus affected. The effect, however, of a vibrating disk of carbon in producing induction currents, or the effect of a magnet in producing vibrations in a disk of carbon, would be excessively minute; and I think it is extremely doubtful if we could detect any effect whatever. I should not expect to be able to detect it with any apparatus now in existence. The effect of any substances except those which are decidedly magnetic would be very slight.

Cross-Int. 94. If the Exhibit Defendants' Transmitter, instead of having a carbon and a platinum electrode, had two carbon electrodes or two platinum electrodes, would such, in your opinion, be equivalent to the mercury and wire conductor mentioned in complainants' patent, as specified in Cross-Int. 91?

Ans. If they were used simply as a means of producing electrical undulations, I think that they would be equivalent to the mercury and conducting wire.

Cross-Int. 95. Can you suggest the propriety of the term "interrupters" [interrupteurs] which Du Moncel applied to the contact pieces in those parts of his work which you quoted in answer to Int. 23?

Ans Du Moncel, as I understand him, is using the term "interrupteur" in a broad sense, as any instrument which serves to interrupt the circuit, whether it is an instrument intended to automatically make and break the circuit, or one which is manipulated like a Morse telegraph key.

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Cross-Int. 96. Is the diaphragm of the transmitter of the Bell '76 patent active in transmitting speech while moving towards the speaker?

Ans. The diaphragm of the transmitter is active during all portions of its vibration. I use the term "active" as meaning, that in consequence of the attachment of the vibrating armature to the membrane, the armature follows the motion of the diaphragm both as the diaphragm moves forward and backward.

Cross-Int. 97. Then the diaphragm moves forward and backward under the influence of an air wave which moves forward only; is that it?

Ans. The diaphragm moves backward and forward under the influence of the alternate condensations and rarefactions which occur at its surface.

Cross-Int. 98. If in the Bell 1876 patent, Fig. 7, the battery were wholly omitted and permanent magnets used, would not the operation of the mechanism, as you have described it with reference to said patent, remain unaffected by such change?

Ans. The only difference would be that when the battery is used, there will be a continuous current, constant in direction, but varying in strength; while if permanent magnets are used, the mode of variation will remain unchanged, but the current will vary its direction.

[*Adjourned.*]

MAY 25, 1885.

Cross-Int. 99. Will you please explain more fully how the current will vary its direction, as stated in your last preceding answer?

Ans. Referring to Fig. 7 of the first Bell patent, let us suppose the battery to be absent and the cores of the electro-magnets to be permanently magnetized; under these circumstances, the operation of the apparatus of Fig. 7 would be substantially identical with the operation of the apparatus shown in Fig. 6 of the Bell patent, No. 186,787. When the armature *c* vibrates to and fro in front of the pole of the electro-magnet *b*, then, in accordance with the well-known principle of electricity, induction currents will be produced in the coils of the electro-magnet *b* and *f*, and the line wire *e* connecting

them. The direction of these currents will depend upon the direction in which the vibrating armature of the transmitter is moving at the moment considered, and the strength of the current upon the velocity of the motion of the armature at that moment; hence the strength of the current will vary from instant to instant as the velocity of the vibrating armature varies, and the direction of the current will be reversed when the armature changes the direction of its motion.

Cross-Int. 100. Then do I understand you to say that the said current always moves in the same direction in which the membrane of the transmitting instrument is moved?

Ans. That was not my statement. The direction in which the current moves in the circuit when the armature *c*, for instance, approaches the magnet *b*, will depend upon the way in which the magnet coils are wound and connected with the circuit; also, when the current is moving through *e* in one direction, it would move through a return wire, were this substituted for the earth circuit, in an opposite linear direction; and if we consider the earth as actually completing the circuit, it would flow through the earth in the opposite direction.

Cross-Int. 101. Is it not true then that the two electro-magnets, *b*, *f*, being connected by two conductors, the said current in one of these two conductors will always travel in the same direction in which the membrane of the transmitter instrument is moved?

Ans. In answering this question, as in answering the previous one, I am assuming that the circumstances are such as I have imagined in my answer to Cross-Int. 99; that is, that there is no battery used in connection with the apparatus. I will also assume that the conducting wires are so short that the current throughout all parts of the circuit is moving in the same direction with reference to the circuit itself at the moment under consideration; that is, that the motion of the current is right-handed or left-handed throughout the whole circuit at the given instant. Under these circumstances, if the current in the line wire *e* is moving in one direction with reference to an external point, the current in a return wire substituted for the earth connection in Fig. 7 will have an opposite direction with reference to that same point, and hence, in either the wire *e* or

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the return wire, will be moving at any given instant, either in the direction in which the membrane and armature are moving, or in the opposite direction. Of course, I exclude from consideration the condition of things in the circuit at the instant when the armature is at the extremity of its vibration and about to begin its motion in the opposite direction.

Cross-Int. 102. Have you ascertained whether, in an instrument constructed according to Fig. 7 of the Bell patent, No. 174,465, the membrane of the receiving instrument moves in the same direction always as does the membrane of the transmitting instrument, or in the opposite direction?

Ans. I have never made any experiments to test this matter, because the direction in which the armature of the receiving instrument would move under the influence of a current moving through the line wire *e*, in either direction, would depend upon the way in which the coil *f* of the receiver was connected with the rest of the circuit.

Cross-Int. 103. When the armature *c* of Fig. 7 of patent 175,-465 approaches its electro-magnet *b*, does or does not the current induced thereby cause the electro-magnet *f* to draw the armature *h* towards it?

Ans. That will depend entirely upon the way in which the instruments are connected with the line wire; and the armature *h* may be pulled either more or less strongly by *f* when the armature *c* approaches the electro-magnet *b*.

Cross-Int. 104. May we then understand you to testify that the objects of Bell's patent, No. 174,465, will be found accomplished in an instrument having the form of Fig. 7, in which the variations of magnetic strength of the magnet *b* will produce in the magnet *f*, not the corresponding variations, but opposite variations?

Ans. I understand you to ask me whether it is any way material to the operation of a receiver similar in its mode of operation to that shown in Fig. 7 of the Bell patent referred to in your question, whether this receiver is so connected with the circuit that its electro-magnet is strengthened at the moment that the electro-magnet of the transmitter is strengthened, or the reverse. If this is the meaning of the question, my reply is that I do not consider it material

whether the magnet *f* is strengthened or weakened at the instant that the electro-magnet *b* is strengthened or weakened, since in either case the electrical undulations which are produced are necessarily similar in form to the air vibrations accompanying them, so that speech is transmitted with equal facility in either case.

Cross-Int. 105. This implies that, in your opinion, precisely the same effect upon the listener is produced, whether the membrane of the receiving instrument makes a certain stroke towards his ear or in an opposite direction; does it not?

Ans. I do not think that you have any right to make this assumption as to my opinion. It seems to me that your interrogatory opens a broad acoustic question as to whether in all cases a condensed wave acting upon the ear would produce exactly the same effect as a rarefied wave of the same form. This opens a somewhat obscure physcial and physiological question, which, as far as I know, has not been studied minutely. From the construction and operation of the human ear, I think that there might be certain minute differences. I do not think, however, that any of these differences would be at all important in the ordinary operation of hearing. It also seems to me that, so far as the operation of the receiving instrument is concerned, there is some misconception implied in your question, if I understand it correctly, since the important thing in the operation of the receiver of a speaking telephone is the way in which the motion of the membrane varies from instant to instant, rather than the way in which it is moving at a given instant. The sensation of sound is a sort of integral effect due to the continuously varying motion of the air and of the vibrating parts of the ear.

Cross-Int. 106. Will you now inform the Court as to what is "the condition of things in the circuit at the instant when the armature is at the extremity of its vibration, and about to begin its motion in the opposite direction"?

Ans. Neglecting all considerations of extra current and magnetic inertia, and supposing no battery to be on the circuit, the current in the line wire will momentarily cease before reversing its direction, in correspondence with the changes in the motion of the armature.

Cross-Int. 107. When, in defining that current, you call it an undulatory current, are we to understand that you find series of

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the return wire, will be moving at any given instant, either in the direction in which the membrane and armature are moving, or in the opposite direction. Of course, I exclude from consideration the condition of things in the circuit at the instant when the armature is at the extremity of its vibration and about to begin its motion in the opposite direction.

Cross-Int. 102. Have you ascertained whether, in an instrument constructed according to Fig. 7 of the Bell patent, No. 174,465, the membrane of the receiving instrument moves in the same direction always as does the membrane of the transmitting instrument, or in the opposite direction?

Ans. I have never made any experiments to test this matter, because the direction in which the armature of the receiving instrument would move under the influence of a current moving through the line wire *e*, in either direction, would depend upon the way in which the coil *f* of the receiver was connected with the rest of the circuit.

Cross-Int. 103. When the armature *c* of Fig. 7 of patent 175,465 approaches its electro-magnet *b*, does or does not the current induced thereby cause the electro-magnet *f* to draw the armature *h* towards it?

Ans. That will depend entirely upon the way in which the instruments are connected with the line wire; and the armature *h* may be pulled either more or less strongly by *f* when the armature *c* approaches the electro-magnet *b*.

Cross-Int. 104. May we then understand you to testify that the objects of Bell's patent, No. 174,465, will be found accomplished in an instrument having the form of Fig. 7, in which the variations of magnetic strength of the magnet *b* will produce in the magnet *f*, not the corresponding variations, but opposite variations?

Ans. I understand you to ask me whether it is any way material to the operation of a receiver similar in its mode of operation to that shown in Fig. 7 of the Bell patent referred to in your question, whether this receiver is so connected with the circuit that its electro-magnet is strengthened at the moment that the electro-magnet of the transmitter is strengthened, or the reverse. If this is the meaning of the question, my reply is that I do not consider it material

whether the magnet *f* is strengthened or weakened at the instant that the electro-magnet *b* is strengthened or weakened, since in either case the electrical undulations which are produced are necessarily similar in form to the air vibrations accompanying them, so that speech is transmitted with equal facility in either case.

Cross-Int. 105. This implies that, in your opinion, precisely the same effect upon the listener is produced, whether the membrane of the receiving instrument makes a certain stroke towards his ear or in an opposite direction; does it not?

Ans. I do not think that you have any right to make this assumption as to my opinion. It seems to me that your interrogatory opens a broad acoustic question as to whether in all cases a condensed wave acting upon the ear would produce exactly the same effect as a rarefied wave of the same form. This opens a somewhat obscure physcial and physiological question, which, as far as I know, has not been studied minutely. From the construction and operation of the human ear, I think that there might be certain minute differences. I do not think, however, that any of these differences would be at all important in the ordinary operation of hearing. It also seems to me that, so far as the operation of the receiving instrument is concerned, there is some misconception implied in your question, if I understand it correctly, since the important thing in the operation of the receiver of a speaking telephone is the way in which the motion of the membrane varies from instant to instant, rather than the way in which it is moving at a given instant. The sensation of sound is a sort of integral effect due to the continuously varying motion of the air and of the vibrating parts of the ear.

Cross-Int. 106. Will you now inform the Court as to what is "the condition of things in the circuit at the instant when the armature is at the extremity of its vibration, and about to begin its motion in the opposite direction"?

Ans. Neglecting all considerations of extra current and magnetic inertia, and supposing no battery to be on the circuit, the current in the line wire will momentarily cease before reversing its direction, in correspondence with the changes in the motion of the armature.

Cross-Int. 107. When, in defining that current, you call it an undulatory current, are we to understand that you find series of

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undulations between the above-mentioned momentary interruptions or cessations of the current?

Ans. I should not use the term "interruption" as applying to this cessation of the current during an infinitesimal interval of time, as such a use of the term might easily lead one to confuse totally different classes of phenomena. The momentary "cessation" of the current is a part of the electrical undulation itself. I do not understand exactly what is meant by the phrase "series of undulations."

Cross-Int. 108. I will try to make my question clearer by reference to the sketches I now hand you, which I have marked Fig. 1 and Fig. 2. What I desire to know is whether the said cessations would appear as at *a b*, Fig. 1, or as in Fig. 2 at *d k*, where they would be separated by undulations.

Ans. It is not apparent to me how these curves are constructed; that is, what variables are represented by the abscissas and ordinates. If you will indicate this to me, I will try and answer the question.

Cross-Int. 109. The curves are intended to be substantially the same as those marked "A" and "B" in Fig. 4 of the Bell patent, 174,465, and are intended further to represent the electrical undulations in the circuit. With this explanation, I repeat the former question.

Ans. It is stated in the description of these curves that a horizontal line *a d e f*, Fig. 4 of the Bell patent, represents the zero of current. Assuming that the points *a b*, Fig. 1 of your sketch, correspond to the points *a e* of Fig. 4 of the Bell patent, the points *a b* would correspond to the infinitely brief cessation of the current.

[*Counsel for defendants offers in evidence the sketch referred to in Cross-Int. and Ans.* 108 *and* 109, *and the same is marked "Defendants' Exhibit Prof. Cross Sketch of Undulations, Chas. H. Swan, Special Examiner."*]

DEFENDANTS' EXHIBIT PROFESSOR CROSS SKETCH OF UNDULATIONS.

Fig: 1

Fig: 2

CHAS. H. SWAN, *Special Examiner.*

Cross-Int. 110. In your answer to Cross-Int. 107, you criticise the use of the words "interruptions" and "cessations," as synonymes for the purpose of characterizing what happens in the Bell telephone. Will you kindly point out the distinctive differences which you find between interruptions and cessations in that connection.

Ans. My reason for using the term "cessation" rather than "interruption" was because the latter term has been so frequently used in telephony to indicate such a change as is produced by breaking or interrupting the circuit suddenly, that in applying it to that gradual and progressive diminution of the current, followed by an infinitesimal period of quiescence, and succeeded by a gradually increasing current in an opposite direction, one might imagine the effects produced in these two cases to be identical. It seems to me as if the term "cessation," as I have used it, indicated far more clearly this change in which the current momentarily ceases because of a variation inherent in the nature of the periodic changes which it undergoes, than the term "interruption," which would, to my mind, rather imply a violent change produced in the current by some extraneous influence, as, for example, by interrupting the circuit. Of course, whenever there is an interruption of the current, there is a cessation of the current; but if I were explaining the subject and desirous of making my meaning as clear as possible, I should not say that whenever there was a cessation of the current, there was an interruption of the current, although the word "interrupt" might doubtless be used in such a sense that this statement would be true; that is, if I used the word "interruption" in this sense, I should feel it necessary to explain very explicitly what I did and what I did not mean by it; whereas, I should feel that the term "cessation" would be understood more readily.

Cross-Int. 111. Have you ascertained by experiment or can you inform us how frequently the diaphragm of a telephone is vibrated per second, when the instrument is used to transmit articulate speech in the ordinary manner?

Ans. Complete vibrations of the diaphragm, that is, vibrations due to the fundamental of the sound transmitted, may occur several hundred times a second, according to the pitch of the voice. For example, a man speaking in a high pitch might cause three hundred

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undulations between the above-mentioned momentary interruptions or cessations of the current?

Ans. I should not use the term "interruption" as applying to this cessation of the current during an infinitesimal interval of time, as such a use of the term might easily lead one to confuse totally different classes of phenomena. The momentary "cessation" of the current is a part of the electrical undulation itself. I do not understand exactly what is meant by the phrase "series of undulations."

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Cross-Int. 111. Have you ascertained by experiment or can you inform us how frequently the diaphragm of a telephone is vibrated per second, when the instrument is used to transmit articulate speech in the ordinary manner?

Ans. Complete vibrations of the diaphragm, that is, vibrations due to the fundamental of the sound transmitted, may occur several hundred times a second, according to the pitch of the voice. For example, a man speaking in a high pitch might cause three hundred

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and fifty complete vibrations, or thereabouts, to be executed in a second.

Cross-Int. 112. Then the aforesaid man would cause the current (there being no battery) to travel three hundred and fifty times to the receiver, three hundred and fifty times to the transmitter, and besides would produce seven hundred "cessations" of the current per second, would he not?

Ans. Assuming that his voice was absolutely free from overtones, which of course could not be, your supposition appears to me to be correct. By travelling "to the receiver" and "to the transmitter," I understand you to mean that the current moves through the line wire *e*, in Fig. 7 of the Bell patent, 174,465, in the direction from *b* towards *f* in the one case, and from *f* towards *b* in the other. Of course, considering the voice as it actually exists, with its full complement of overtones, the electrical phenomena are much more complicated than your question supposes them to be.

Cross-Int. 113. Referring to the Bell patent, No. 174,465, do you find the same to distinguish between induced currents and voltaic currents; or are both kinds of currents in that patent meant to describe the same thing?

Ans. In the Bell patent referred to, I find mention of both induced and voltaic currents. I do not understand the last part of the question.

Cross-Int. 114. You find in the Bell patent, No. 174,465, reference to "both induced and voltaic currents." For the purpose of reading that patent, is there or not any distinction between the induced and voltaic currents?

Ans. I do not think that I yet understand the idea embodied in your question. The terms "induced and voltaic currents" have meanings which have been well understood to students of electricity for fifty years. If I am asked whether it is material to the operation of the telephone whether the electrical undulations utilized are produced in a voltaic current or whether they are produced in an induced current, my answer is that it is not material.

Cross-Int. 115. Take Fig. 7 of said Bell patent. When that instrument, as shown, is put in operation, there is a voltaic or battery current, and there is also the induced current produced by the movements of the transmitter armature; am I not right?

Ans. In my answer to Int. 34, in this deposition, I have endeavored to explain briefly the condition of things in Fig. 7. There is, in reality, at any instant, one current strength, and one current strength only, at a given point in the circuit. The strength of this current is dependent simply upon the electro-motive force in the circuit at that instant, supposing the resistance of the circuit to remain constant. The electro-motive force at any instant is equal to the electro-motive force due to the battery, which we may suppose constant, plus the electro-motive force given at that instant by the velocity of the armature. We may conveniently study the electrical changes occurring in the circuit by imagining the current at any moment to be equal to the sum of two currents, a constant voltaic current determined by the electro-motive force of the battery, and a variable induced current determined by the variable electro-motive force due to the moving armature. In doing this we are merely following the ordinary geometrical methods of the resolution of forces or resolution of motions, in which we, in imagination, replace a single variable by several variables, or, as in the exact case before us, by a variable and a constant. In what I have said in this answer, I am, as in previous cases, omitting all consideration of self-induction and similar phenomena, the consideration of which is not essential to understanding the operation of Fig. 7.

Cross-Int. 116. Are we to understand from your last answer, that the battery current, Fig. 7, Bell patent No. 174,465, is undulated and subjected to the cessations about which you have already testified, whenever the instrument is used as a telephone?

Ans. Electrical undulations are produced in the circuit, and as the battery current is presumably stronger than the current which would be produced solely by the inductive action of the armature, we may with propriety speak of the battery current as being caused to become undulatory by the vibration of the armature. Of course, under the circumstances supposed there will not be any "cessation' of current in the circuit.

Cross-Int. 117. Then why did you assert in answer to Int. 14, "The object of the battery shown in Fig. 7 is *simply* to produce this current, which shall cause the cores to be kept magnetized"?

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Ans. For the reason that this is the only object of employing the battery with the apparatus. If, instead of magnetizing the cores by a current from a battery, we magnetize them in any other way, as by placing them in contact with a permanent magnet, the apparatus still acts to produce electrical undulations and to transmit speech as before.

Cross-Int. 118. You have testified, in answer to Cross-Ints. 106 to 110, that a telephone such as shown in the Bell patent No. 174,465, when used without a battery, but with magnetized cores, produces what I would term "reciprocating currents"; that is, currents varying in their direction, there being cessations at every change of direction. You have further testified, in answer to Cross-Int. 116, that as soon as you put the battery in that instrument you get the current without the cessations. Now, please tell us whether the defendants' instruments, in your opinion, infringe that Bell patent because they use the first, or because they use the second kind of current, about which you have testified?

Ans. In my opinion, the defendants' instruments embody the method of and apparatus for transmitting vocal or other sounds telegraphically by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, as described in the Bell patent referred to, and claimed in the fifth claim thereof. In the primary circuit of the defendants' instrument, as I have explained in my answer to Ints. 38 and 39 in this deposition, electrical undulations will be produced in a battery current, and in this circuit there will be no cessation or reversal of current. In the line wire and receiving instrument, since an induction coil is used, there will also be electrical undulations, and in this current there will be reversals, and also what I have called "momentary cessations of the current."

[*Adjourned.*]

MAY 26, 1885.

Cross-Int. 119. Does, in your opinion, the fifth claim of said patent, 174,465, apply to the apparatus shown in Fig. 7 when operated with a battery; and also when operated without a battery, but with magnetized cores in lieu thereof?

Ans. It does.

Cross-Int. 120. Does said fifth claim also apply to the apparatus which is shown in Fig. 6 of said patent, and to the method of using the same, as described in the patent?

Ans. I should think that it would, though the apparatus of Fig. 6 would not be adapted, of course, to transmit speech.

Cross-Int. 121. Is the apparatus shown in Fig. 6 of patent 174,465 adapted for transmitting vocal or other sounds?

Ans. You can transmit certain sounds by it, both certain sounds produced by the voice and certain other sounds. Whether the apparatus would have any practical value for this specific purpose, I can hardly say.

Cross-Int. 122. What causes you to assert that that apparatus will not transmit speech?

Ans. My statement was that the apparatus would not be adapted to transmit speech. By this I did not mean that it would be absolutely impossible with an apparatus constructed on the general plan of Fig. 6 to transmit to a certain extent some articulate sounds; but that its construction was not such as one familar with acoustics would use for this purpose. I should expect such an apparatus, if it gave any effect at all, to work very imperfectly. As a matter of fact, Prof. Bell himself devised an apparatus of this general character for transmitting speech, which he described in his London lecture before the Society of Telegraph Engineers, in 1877.

Cross-Int. 123. In testifying respecting the first Bell patent, No. 174,465, and the supposed infringements thereof, have you considered said patent as being for the method of and apparatus for transmitting vocal or other sounds merely, or for transmitting articulate speech, in contradistinction to mere transmission of sounds?

Ans. Your question, I suppose, refers particularly to my testimony concerning the embodiment of the matters claimed in the fifth claim of the patent in the defendants' instruments. In that testimony, I have considered this claim as being one, not for the simple purpose of transmitting vocal or other sounds telegraphically by any and all methods, but as a claim for the method and apparatus of transmission of such sounds invented by Mr. Bell, namely, by causing electrical undulations similar in form to the vibrations of the air

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accompanying such sounds. I have, of course, referred specifically and in detail to the use of this method in the transmission of articulate speech, since it is the ability to secure this result by using the method invented by Mr. Bell, and claimed by him in the fifth claim in the patent in question, that gives to that method its great practical value.

Cross-Int. 124. If an apparatus were adapted to transmit vocal or other sounds telegraphically by the method described in the Bell patent, 174,465, but were not adapted to transmit articulate speech, how would such apparatus and method compare, in your opinion, with the invention sought to be covered by the fifth claim of said patent?

Ans. I always find it difficult to answer with precision questions as to hypothetical pieces of apparatus, especially as one can never be certain that the apparatus, as it lies in the mind of the questioner, is substantially identical with the apparatus framed by the witness in his own mind. If you will describe to me the specific construction of such apparatus as you suggest, so that I can be sure that I understand precisely what it is and how it operates, I will endeavor to answer your question.

Cross-Int. 125. Take, for example, the apparatus shown in Fig. 5 of the Bell patent, 174,465. If any one should make such an apparatus, would he not infringe the fifth claim of said patent, so far as that claim calls for an apparatus?

Ans. I should think that if the apparatus shown in Fig. 5 was so used as to transmit sound telegraphically by producing electrical undulations similar to the air waves accompaning the acoustic vibrations, that it would embody the subject matter claimed in the fifth claim.

[*Answer objected to as not responsive.*]

Cross-Int. 126. I repeat the last question; and call your attention to the fact that it treats of the apparatus only, without any reference to the method of using the same. In other words, I desire to know whether you would regard apparatus of that particular construction to be within the fifth claim of said patent, even if you did not know how that apparatus was intended to be used.

[*Objected to as inadmissible and incompetent, because calling for an expression of opinion upon a question of law.*]

Ans. I do not know how to form an opinion on the subject which you are questioning me about, unless I know or surmise the manner in which such an apparatus is to be used. I cannot see how an apparatus can be an apparatus for doing a certain thing unless it is to be so operated as to do that thing. It seems to me that the apparatus and the way in which it is to be used are so closely connected that they cannot be separated from each other.

Cross-Int. 127. Is the apparatus shown in Fig. 5 of patent 174,475 adapted to transmit articulate speech?

Ans. It is not. By this I do not mean that it would necessarily be impossible to construct this apparatus in such a form that some of the characteristics of articulate speech might be transmitted; but that it is not a suitable apparatus for that purpose.

Cross-Int. 128. When the apparatus which is shown in said Fig. 5 is operated according to the description of the patent, how are the the vibrations of the air produced which accompany the transmitting sound?

Ans. I do not understand distinctly what is meant by the words "transmitting sound" in the question.

Cross-Int. 129. I mean the sound at the transmitting station, in contradistinction to the sound at the receiving station.

Ans. The patent does not describe minutely the way in which the armature is to be set into vibration. I find this statement: —

"The armature *c* can be set in vibration in a variety of ways, one of which is by wind, and in vibrating it produces a musical note of a certain definite pitch."

This is the only statement which I observe regarding the matter. I suppose that in this case the armature might, for example, be attached to the tongue of the reed of a reed organ, or it might constitute that tongue. In this case, the air vibration would, of course, be due to vibration of the reed.

Cross-Int. 130. Do you find in the Letters Patent No. 174,465 the combination with an electro-magnet of a plate of iron or steel or other material capable of inductive action, which can be thrown into

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accompanying such sounds. I have, of course, referred specifically and in detail to the use of this method in the transmission of articulate speech, since it is the ability to secure this result by using the method invented by Mr. Bell, and claimed by him in the fifth claim in the patent in question, that gives to that method its great practical value.

Cross-Int. 124. If an apparatus were adapted to transmit vocal or other sounds telegraphically by the method described in the Bell patent, 174,465, but were not adapted to transmit articulate speech, how would such apparatus and method compare, in your opinion, with the invention sought to be covered by the fifth claim of said patent?

Ans. I always find it difficult to answer with precision questions as to hypothetical pieces of apparatus, especially as one can never be certain that the apparatus, as it lies in the mind of the questioner, is substantially identical with the apparatus framed by the witness in his own mind. If you will describe to me the specific construction of such apparatus as you suggest, so that I can be sure that I understand precisely what it is and how it operates, I will endeavor to answer your question.

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Ans. I should think that if the apparatus shown in Fig. 5 was so used as to transmit sound telegraphically by producing electrical undulations similar to the air waves accompaning the acoustic vibrations, that it would embody the subject matter claimed in the fifth claim.

[*Answer objected to as not responsive.*]

Cross-Int. 126. I repeat the last question; and call your attention to the fact that it treats of the apparatus only, without any reference to the method of using the same. In other words, I desire to know whether you would regard apparatus of that particular construction to be within the fifth claim of said patent, even if you did not know how that apparatus was intended to be used.

[*Objected to as inadmissible and incompetent, because calling for an expression of opinion upon a question of law.*]

Ans. I do not know how to form an opinion on the subject which you are questioning me about, unless I know or surmise the manner in which such an apparatus is to be used. I cannot see how an apparatus can be an apparatus for doing a certain thing unless it is to be so operated as to do that thing. It seems to me that the apparatus and the way in which it is to be used are so closely connected that they cannot be separated from each other.

Cross-Int. 127. Is the apparatus shown in Fig. 5 of patent 174,475 adapted to transmit articulate speech?

Ans. It is not. By this I do not mean that it would necessarily be impossible to construct this apparatus in such a form that some of the characteristics of articulate speech might be transmitted; but that it is not a suitable apparatus for that purpose.

Cross-Int. 128. When the apparatus which is shown in said Fig. 5 is operated according to the description of the patent, how are the the vibrations of the air produced which accompany the transmitting sound?

Ans. I do not understand distinctly what is meant by the words "transmitting sound" in the question.

Cross-Int. 129. I mean the sound at the transmitting station, in contradistinction to the sound at the receiving station.

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This is the only statement which I observe regarding the matter. I suppose that in this case the armature might, for example, be attached to the tongue of the reed of a reed organ, or it might constitute that tongue. In this case, the air vibration would, of course, be due to vibration of the reed.

Cross-Int. 130. Do you find in the Letters Patent No. 174,465 the combination with an electro-magnet of a plate of iron or steel or other material capable of inductive action, which can be thrown into

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vibration by the movement of surrounding air or by the attraction of a magnet?

Ans. I do not find anything which seems to me to be properly described in those words.

Cross-Int. 131. Is not the armature *c* of Fig. 7 of said patent a plate of iron or steel?

Ans. I should not apply that term to it.

Cross-Int. 132. Is the armature *c*, Fig. 7, of that patent, capable of inductive action?

Ans. It is.

Cross-Int. 133. Can the armature *c*, Fig. 7, of that patent, be thrown into vibration by the movement of the air or by the attraction of a magnet?

Ans. It can be thrown into vibration by the action of the magnet, but it is not adapted to be thrown into vibration by the motion of the air. The air vibrations act upon a membrane which is adapted to take up such vibrations, and the armature *c* is caused to vibrate through its connection with the membrane.

Cross-Int. 134. Referring to the sketch marked "Defendants' Exhibit Professor Cross's '72 Lecture Instrument," and to the instrument itself, part of which, as you say, Prof. Bell probably saw, was there in that an electro-magnet combined with a plate of iron or steel or other material capable of inductive action, which can be thrown into vibration by the movement of the surrounding air or the attraction of a magnet?

Ans. There was; namely, the plate formed by the bottom of the tin box E and the electro-magnet D. I should observe that in the cut referred to, and reproduced on p. 155 of the printed record, the bottom of the box is represented by the vertical line opposite the poles of the electro-magnet D.

Cross-Int. 135. In using that instrument during your lectures, did you always use the tin box opposite the electro-magnet, or did you not at times use a mere tin plate?

Ans. In the 1872 and 1873 lectures, the only lectures in which I distinctly recollect having exhibited the apparatus in operation, I made use of the box only.

Cross-Int. 136. Then you never made use of a mere tin plate opposite that electro-magnet, did you?

Ans. I do not remember that I ever used such a plate in operating the apparatus. I may have described the use of a plate instead of a box, since the box was used merely as a convenient way of getting a plate.

Cross-Int. 137. Can you inform us where, if at all, reports of these lectures, or of any of them, can be found, or any publications respecting them?

Ans. I do not remember that there were any reports of the 1873 lectures. I believe that there were some reports of the 1872 lecture published. I have an impression that there was some notice of that lecture in one of the Boston papers, but I do not recollect which one. I also feel quite certain that there was a fuller report in some musical journal, but I have forgotten entirely what the name of the journal was. I think that I had a copy of the latter once, but I have not seen it for a number of years.

Cross-Int. 138. When first, if at all, did you testify respecting these lectures, and in what cause was such testimony given?

[*Objected to as inadmissible, because relating to subject matter not opened in the direct examination and as immaterial.*]

Ans. In June, 1879; I do not remember the cause in which it was given.

Cross-Int. 139. Have you a copy of such testimony?

[*Same objection.*]

Ans. I have had what purported to be a copy of that testimony, but I never compared it with the original. It is not at present in my possession, as I loaned it some time ago, and it has not yet been returned to me.

Cross-Int. 140. Can you get it into your possession so that it may be produced here to-morrow?

[*Same objection.*]

Ans. I think it is very doubtful if I can do so.

Cross-Int. 141. Can you tell us who has possession of it?

[*Same objection.*]

Ans. It was lent to Prof. Pickering since the last examination.

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Cross-Int. 142. Was not your testimony of June, 1879, given in the suits entitled the Harmonic Telegraph Company *et al. v.* New England Telephone Company, and Same *v.* Charles Williams, Jr., in behalf of the defendants?

Ans. I do no know certainly whether that is the case or not. I was at the time giving a deposition in the Dowd case, and at that time did not distinguish between the two cases. I think, however, that one of the parties named in the case was the Harmonic Telegraph Company; I do not know about the other parties.

Cross-Int. 143. Have you taken steps towards getting your copy of that testimony back into your possession?

Ans. Several days ago Prof. Pickering told me that he would return it shortly, and thinking that it might be wanted, I sent for it last night. After leaving this office this morning and going to my study, I found that it had been left on my desk. I have placed it in the hands of complainants' counsel, Mr. Roberts, to use as he sees fit.

Cross-Int. 144. Can you inform us of whom you originally obtained that copy?

Ans. The copy was originally sent me from the office of J. J. Storrow, Esq.

Cross-Int. 145. Was he the counsel who examined you at that time?

Ans. Mr. Storrow and Mr. Chauncey Smith were both counsel, and I am not certain which examined me. I think it was Mr. Storrow.

[*Counsel for defendants requests counsel for complainants to produce the copy of testimony which the witness handed him to-day, as stated in answer to Cross-Int.* 143.

Counsel for complainants states that he has reason to believe that the original deposition referred to is in existence; and that he desires time to procure it and have it compared with the supposed copy; that Mr. Storrow is now absent from the city, and that upon his return the matter will be attended to. Counsel for complainants further states that while he regards the said deposition as immaterial and irrelevant to the issues in the present case, and as legally inadmissible because relating to a subject matter not opened in the direct examination, and

objects to it as such, he has no objection other than these technical objections to the introduction in evidence of the copy called for as soon as its correctness is proved.

Counsel for defendants replies that if the copy be produced, it will, of course, be upon the condition that any mistakes therein may be corrected when the original is found.

The copy referred to is handed to counsel for defendants.]

Cross-Int. 146. Please look at the paper now shown you, and state whether it is the copy of your testimony, to which you have referred.

Ans. It is.

[*Counsel for defendants requests the examiner to mark the said copy for identification, and it is accordingly marked "Chas. H. Swan, May 26th, 1885."*]

Cross-Int. 147. Will you please hear the examiner read said testimony; and state whether it contains a correct statement of facts within your present knowledge.

[*Objected to as immaterial, irrelevant and inadmissible for the reasons already given. The testimony is read by the examiner.*]

Ans. All of the facts regarding my own experiments are correct, as far as I can recollect. One or two points with regard to Prof. Pickering's experiment might be slightly modified were I stating my impressions anew, as I have talked over the subject at some length with him and Mr. Ross since that time.

Cross-Int. 148. We would be happy to have you make such corrections as you think proper to insert at this time.

Ans. The principal point is the following: I had always remembered the diaphragm of the receiver which I was shown, as being a tin plate with an armature attached to it by a wire. Shortly before giving the deposition in the Harmonic Telegraph suits, Mr. Chauncey Smith had called my attention to a paragraph in the *Troy Times* reporting a description of the apparatus, which Prof. Pickering had given at a meeting of the American Association for the Advancement of Science, at Troy, from which it appeared that a plate must have been described at that meeting. I also had a very indistinct recollection of the use of a small box, which was certainly used in 1872. I was also under the impression that Prof. Pickering

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recollected the experiment with the box more clearly than the experiment with the plate and armature, which rendered me unwilling to speak more positively than I did in my answer to Int. 6 in that deposition. I feel very positive at this time that my recollection with regard to the armature was correct; but I think that I must also have known of the use of a plate or box at the time, and afterwards forgotten it, for I have no distinct recollection regarding this.

There is one other point which I wish to mention: —

The instrument which I have spoken of in my answer to Int. 2 as a Reis receiver, was an instrument substantially identical in its construction with that instrument; but with a long box and a long bar for which I had substituted a number of small bars.

I also think that I remember being told that in his early experiment Mr. Pickering placed the electro-magnet vertically within a box, over the top of which was laid the diaphragm and armature.

[*Counsel for defendants now offers in evidence the testimony of this witness in the Harmonic Telegraph Company case, and it is marked "Prof. Cross's Harmonic Telegraph Deposition, C. H. S., Special Examiner."*

It is objected to as immaterial and irrelevant, and also as inadmissible, because relating to matters not opened in the direct examination.

It is agreed that the examiner may correct this copy by the original, if found.]

Cross-Int. 149. When, in using the instrument during the lectures referred to by you, a spark was produced, was that spark produced by the main battery current, or by an induced current?

Ans. The spark was produced by the sudden interruption of a battery current in a circuit containing an electro-magnet. Of course, under these circumstances, the "extra current" was quite strong. The spark would, of course, be less strong if the electro-magnet were absent.

Cross-Int. 150. You have not answered my question. I want to know whether the spark is produced by the main or battery current, or not.

Ans. Yes and no. The question is one which it is not easy to answer categorically. In any circuit containing an electro-magnet,

there is an electro-motive force, due to the self-induction of the circuit depending upon the rate of change in the strength of the primary current and opposing it. In proportion as this extra current is stronger, the spark is stronger; but there is always a spark even when there is no electro-magnet in the circuit. There would be no spark if the battery current did not exist in such a circuit as I have described, while there would be a spark, though a much smaller one, if there were no electro-magnet in the circuit.

Cross-Int. 151. At the time you made these experiments, did you know of the method devised by Helmholtz (pp. 604–607, 1875, London edition), of inserting a condenser in such an apparatus, so as to get rid of the spark?

Ans. I think that I must have known of this arrangement, but cannot say positively that I knew of the specific method which Helmholtz had described. I must have been familiar with the means ordinarily used for preventing such a spark.

[*Counsel for defendants gives notice that at the hearing he will read certified copies of the pleadings in the Harmonic Telegraph Company cases to which the testimony of Prof. Cross of June*, 1879, *relates.*

Adjourned.]

MAY 27, 1885.

Cross-Int. 152. What would be the effect of inserting an induction coil in the line wire *e* of the apparatus shown in Fig. 7 of patent 174,465, such as you find in defendants' transmitter?

Ans. I understand your question to suppose that the primary wire of the induction coil is placed in a closed circuit with the battery and the electro-magnet *b*, and that the electro-magnet *f* of the receiver is placed in the secondary circuit of that coil. With this arrangement, speech would still be transmitted as before.

Cross-Int. 153. Have you ever tried it?

Ans. I have a strong impression that I have tried it with this specific form of apparatus, but should prefer consulting my notes if a positive answer is desired. My recollection of some experiments of this kind is this, that I have placed a receiver and transmitter like those of Fig. 7, in a battery circuit which included the primary of a small induction coil, and had in the secondary circuit of that

coil, at the same time in some experiments, an ordinary magneto-receiver, and in other experiments, a duplicate of the receiving apparatus L of Fig. 7, speech being perfectly understood in all the receiving instruments. I cannot say, certainly, without reference to my notes, whether I tried this particular experiment with a transmitter like A in the primary circuit, and a receiver like L in the secondary circuit, but without any receiver in the primary circuit. I feel quite confident, however, that I have done this.

Cross-Int. 154. What would be the effect upon the defendants' instruments if the induction coil were taken out and a simple battery connection established, as in Fig. 7?

Ans. Speech could still be transmitted perfectly well over a short line, though one would probably get better effects by adjusting the resistance of the receiving instrument to correspond to the altered conditions of the circuit.

Cross-Int. 155. Have you ever tried it?

Ans. I do not remember that I have tried this experiment with the specific form of microphone referred to in your question, but I have tried it with various other forms.

Cross-Int. 156. When you say that the omission of the induction coil would leave the defendants' apparatus operative for short lines, do you wish to be understood as testifying that, in your opinion, the defendants' apparatus would be a commercially and practically useful telephone without the induction coil?

Ans. I do. Of course, its use would be more limited, but I see no reason why this particular microphone should not be useful even without the induction coil under various circumstances, which I am certain would be the case with certain other forms of microphone.

Cross-Int. 157. What would be the effect, in your opinion, of inserting an induction coil, in the manner heretofore stated, in the Reis apparatus, which is illustrated next after your answer to Cross-Int. 84?

Ans. I do not feel willing to answer this question definitely, never having tried any experiments upon the point. It would depend upon the size of the receiving electro-magnet, and upon the amount of residual magnetism in its cores.

Cross-Int. 158. Is there in the defendants' instrument anything that, in your opinion, serves as a spark arrester?

Ans. I have not observed anything which seemed designed to serve that purpose. The secondary of the induction coil will, of course, have its reactive effect upon the current in the primary circuit.

Cross-Int. 159. What kind of a spark arrester do you think was referred to by Bell in his first patent?

Ans. I do not know that Mr. Bell had any special form of spark arrester in mind. He may have had in his mind a high resistance interposed between the contact pieces of the circuit breaker, or a condenser interposed between them, or perhaps such a combination of the two as was used by Helmholtz.

Cross-Int. 160. Can the defendants' instrument be so used that words spoken into the Exhibit Defendants' Receiver will be heard at the Exhibit Defendants' Transmitter?

Ans. If I understand the question correctly, I am asked whether words spoken into the Exhibit Defendants' Receiver can be heard by means of the Exhibit Defendants' Transmitter acting as receiver. I do not think that you could thus transmit speech, but am not certain that you could not, since it is possible to use the microphone under certain circumstances as a receiver.

Cross-Int. 161. Have you in your last answer supposed the presence or absence of an induction coil in the circuit?

Ans. I tried to word my answer so that it would be true on either supposition. I should expect to find it more difficult to transmit speech with the induction coil as arranged in the exhibit than without it, though I cannot be absolutely certain of this.

Cross-Int. 162. The apparatus shown in Fig. 7 of Bell patent, 174,465, can be used with the same effect whether A or L is used as receiver, can it not?

Ans. It could, if it were not for the fact that the cone of L is adapted to enter the ear, so that it is difficult to speak into it.

Cross-Int. 163. Do you mean to answer my last question in the negative; or is not the shape of the cone an immaterial element?

Ans. Theoretically speaking, it is immaterial, though no one would think of constructing such a cone on a transmitting instru-

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ment. I did not intend to answer the question in the negative, but on the contrary, think that either by speaking into the cone L, or by speaking against the membrane *i*, from the outside speech could be transmitted.

Cross-Int. 164. And did not Bell evidently mean this when in his said patent he says, "Communication in both directions is established without the necessity of special induction coils"?

Ans. In the paragraph from which the quotation that you make is taken, there is no reference to Fig. 7, but merely a statement of the advantages which the inventor expects to gain from the use of an undulatory current. Of course, it is evident that by a very slight and well-known modification of the cones of the apparatus, this ready ability to communicate in both directions will immediately be secured.

[*Answer objected to as not responsive.*]

Cross-Int. 165. Do you or not deem it essential for the purpose of construing the specification of Letters Patent No. 174,465, that by the use of the undulatory current therein referred to, communication in both directions is established?

[*Objected to as calling for an expression of opinion upon a matter of law.*]

Ans. It does not seem to me essential to keep this in mind, since it is simply one advantage which the inventor claims to derive from the use of the undulatory current.

Cross-Int. 166. As matter of fact, is it a result inherent in the use of such a current?

Ans. You can, of course, use the undulatory current with an apparatus by means of which you cannot secure this advantage if you see fit to do so.

Cross-Int. 167. During your cross examination, and more particularly in the testimony given in the Harmonic Telegraph Company suits, you referred to experiments made which demonstrated the fact that the receiver of 1872–74 could be used as a receiver in the transmission of articulate speech. Did you or not also experiment with the tuning-fork transmitter of that instrument, to ascertain whether it could be used in a speaking telephone as a transmitter?

[*Ojected to as inadmissible, because relating to a subject matter not opened in the direct examination, and as immaterial and irrelevant.*]

Ans. I did not.

Cross-Int. 168. Did you ever try to use that receiver as a transmitter?

[*Same objection.*]

Ans. I do not remember ever having done this, but cannot say positively that I have not tried it.

Cross-Int. 169. Will your notes show?

[*Same objection.*]

Ans. I am not quite certain. I should not be willing to say, from the absence of this experiment in my notes, that I did not try it, though I think I should have made a note of it if I had tried it.

Cross-Int. 170. Did you ever try to use the transmitter of that 1872–74 instrument as a receiver?

[*Same objection.*]

Ans. I have not done so.

Cross-Int. 171. When first did you announce, either publicly or as a witness, that speech could be transmitted telegraphically, or words to that effect?

Ans. I do not recollect when I first made such a statement.

Cross-Int. 172. Which is the first statement of that character which you do recollect?

Ans. The first specific statement, that I distinctly recollect, was made in my lecture of February, 1872, though I had doubtless made similar statements to my Institute classes before that date.

Cross-Int. 173. Are the parts of that 1872–74 instrument still in existence?

[*Same objection as to Cross-Int.* 167.]

Ans. All the essential parts are still in existence.

Cross-Int. 174. Were you not recently invited to show these parts to Prof. Pickering and to a gentleman who was with him?

[*Same objection.*]

Ans. I was.

Cross-Int. 175. Those parts still belong to the Institute of Technology, do they not?

[*Same objection.*]

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Ans. They do.

Cross-Int. 176. Did you or not, at the time you were invited to show these parts to Prof. Pickering and his companion, invite complainants' counsel, Messrs. Roberts and Smith, to be present, or notify them of the request?

[*Same objection.*]

Ans. I did not invite them to be present. I did notify Mr. Roberts that Mr. Pickering had written me that he had agreed to meet two gentlemen at the Institute on a specific afternoon, and that they would like to see the parts of the apparatus.

Cross-Int. 177. And were said counsel present at that interview?

[*Same objection.*]

Ans. They were.

Cross-Int. 178. What reason had you for notifying Mr. Roberts, as stated in your answer to Cross-Int. 176?

[*Same objection.*]

Ans. Because of a statement of Prof. Pickering's in which, if I recollect rightly, Mr. Von Briesen's name was mentioned, or from something said or written from which I inferred that the gentlemen in question were connected with Mr. Von Briesen. It did not seem to me proper that still being under cross examination by Mr. Von Briesen, I should have any conversation with gentlemen who stood in any legal relation to him. I therefore sent word to Mr. Roberts that I should not be there to meet the gentlemen in question, and held a conversation with Mr. Pickering by telephone, in which I called his attention to the real state of the case. I understood him to agree with me that we two had better talk over the matter together, and see now closely our recollections coincided. We had arranged to meet on an afternoon two days later and do this. I also told him by telephone that of course I had no objection, that afternoon or at any time, to having himself or any gentlemen whom he might bring with him look over the apparatus, and that I should be very glad to get out the apparatus and place it all together where they could see it, but that I should not have time to do that until the next day.

The matter was thus left between Mr. Pickering and myself, and I did not expect to see him until Thursday, two days later. The

word which I sent to Mr. Roberts was a verbal one, and he, apparently thinking that some of the defendants' experts and legal advisers were to be there that afternoon, deemed it proper, since I was still under cross examination in the present case, that the complainants in this case should be similarly represented. Mr. Roberts and Mr. Chauncey Smith therefore came to the Institute early in the afternoon, just as I was about leaving. We were conversing together a few minutes later, when Prof. Pickering came in, and said that having no other way of communicating with the gentlemen who wished to see the instruments, he had come over to the Institute to inform them of the change in plan. A few moments afterwards Mr. Randall, who had been present throughout a large part of my whole deposition a few days before, appeared together with Mr. Seixas. It seemed best, since they had met there, not to trouble them to come again, and they were therefore shown everything which they desired to see. Mr. Randall made measurements of the electro-magnets, from which a duplicate was to be made. He also borrowed a tuning fork (which I told him, however, was not one which, according to the best of my recollection, was used in the experiments of 1872–74), from which a duplicate was also to be made. At the same time I told him what he had better do to be sure that he might obtain a correct duplicate.

I think that I have somewhat transcended the limits which a strict reply to your question would necessitate, but have thought that the facts which you desired to ascertain would be more clearly understood than if I made a briefer statement. This occurred on the afternoon of Tuesday, May 12, 1885.

Cross-Int. 179. It seems to me that your answer to Cross-Int. 97 does not wholly conform to so much of your answer to Int. 14 as refers to the motion of the membrane under the influence of its tension. Will you kindly make your meaning clearer?

Ans. In Cross-Int. 97, my answer referred to the motion of the diaphragm of the transmitter. My answer to Int. 14 refers in one place to the motion of the diaphragm in the receiver, and in another place to the motion of the membrane of the transmitter. Of course, both in the transmitter and receiver, the membrane is set into a state of sympathetic vibration, and its tension is an

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important factor in both cases. In the case of the transmitter, the sympathetic vibration is produced by the variations in the air waves acting upon the stretched membrane. In the case of the receiver, the sympathetic vibration is due to the action of the variations in the strength of the magnet upon the armature attached to the stretched membrane.

Cross-Int. 180. Having in view your explanation of the action of defendants' transmitter, and your assertion that the electrodes of that transmitter never separate when the instrument is in use as a telephone, I presume that you regard so much of the description of the Edison telephone as is contained in his English patent, No. 2,909, of 1877, p. 10, line 49, to p. 11, line 3, inclusive, as incorrect, in that it mentions the separation of the electrodes. Am I right?

[*So much of the interrogatory as relates to the Edison English patent named objected to as inadmissible, because matter not opened in the direct examination, and also as immaterial.*]

Ans. Since there is an implication contained in the first part of your question, before attempting to answer the latter part, I shall be very glad if you would indicate to me the specific assertions to which you refer. I can then understand your meaning more clearly than I do at present.

Cross-Int. 181. Do the electrodes of defendants' transmitter separate when the instrument is in use as telephone?

Ans. They do not separate in the normal operation of the instrument; but as I think I have explained in some part of my deposition, they may separate under certain circumstances, as, for example, when one speaks too loud, or when the normal pressure between the electrodes is too slight.

Cross-Int. 182. [*Cross-Int.* 180 *repeated, adding the word "normally" before the words "in use."*

Same objection.]

Ans. I have never, as far as I remember, read the Edison English patent referred to, and should prefer having time to read the whole of it carefully before considering the subject matter of this question at all.

[*Adjourned to June* 18, 1885, *at* 10 A. M.]

JUNE 18, 1885.

Cross Examination continued by A. Q. KEASBEY, Esq.

Cross-Int. 183. In your answer to Cross-Int. 181, speaking of the electrodes of the defendants' transmitter, you say they do not separate in the normal operation of the instrument, but may separate under certain circumstances, as when one speaks too loud, or when the normal pressure between the electrodes is too slight. Will you explain what you mean by the normal operation and the normal pressure?

Ans. By the normal operation I mean the operation which takes place when speech is transmitted in the ordinary manner by microphonic action. I consider any disturbance, as a grating or crackling, such as is produced, for example, if one shouts into the instrument, to be abnormal, since these noises are elements foreign to the speech which it is desired to transmit. The instrument is not, under these circumstances, acting as it is intended to act in the transmission of speech.

By normal pressure, I mean the pressure which is caused to exist between the electrodes when speech is not being transmitted. It is a well-known fact that to secure the best results in the transmission of speech, this pressure should be neither too great nor too small, though it may be varied within a considerable range.

Cross-Int. 184. Do you consider that the question whether a separation of the electrodes occurs during the use of the instrument, depends upon the loudness of the voice acting upon the diaphragm?

Ans. With a microphone transmitter adjusted with a moderate normal pressure, such as is commonly used for the transmission of speech, by increasing the loudness of the voice we can produce disturbances in the operation of the instrument, and if we speak with sufficient intensity the electrodes can be made to part contact. The changes in the action of the instrument, under these circumstances, are very evident to one listening at the receiving instrument.

Cross-Int. 185. Do you not find in the Reis lecture, at the bottom of page 542 of the Dolbear case, language used by Reis which indicates that, as matter of fact, care was taken not to sing very loud

into his apparatus in another house three hundred feet away, in which the instrument used as a transmitter was placed, so that the undue parting of the contacts might not be produced?

Ans. I find in the Reis lecture referred to this statement: —

"Now, in reference to the capabilities of the telephone, it may be stated that I was enabled to render audible to the members of a large assembly (the Physical Society at Frankford-a-M.), melodies which were sung not very loud into the apparatus in another house three hundred feet away, with closed doors."

The statement is that the melodies were sung not very loud. I should infer from this, not that they were sung very gently, but that they were not sung with as great an intensity as might be used. From the context I should infer that the statement that they were "sung not very loud" is made for the same reason that the distance of the other house, and the fact that its doors were closed, are mentioned, namely, to exclude the supposition that the melodies which were heard were transmitted through the intervening air, and not through the telephonic apparatus.

However this may be, I am quite sure that as a matter of fact, the melodies transmitted in the experiments referred to in this paragraph were transmitted by a making and breaking of the circuit, not only because this is the sole method described by Reis, but also because he states in this same paragraph that the melodies which were transmitted were rendered audible to the members of a large assembly. The necessary loudness of the sound given out by the Reis receiver, or by any receiver, can be secured when the Reis transmitter acts as a circuit-breaker, but not if it is so operated as to transmit a melody by microphonic action without breaking the circuit.

Cross-Int. 186. Does not the fact that he mentions the distance and the closed doors, and expressly states that sufficient precautions were taken to insure that there was no direct conduction of sound, make it clear that the statement that the melodies heard were sung not very loud had reference to the mode of using the instrument in order to make it efficient?

Ans. Not at all. It seems to me that the interpretation which I have given to the sentence is the only natural one. I am confirmed in that view by the relation in which this stands to the earlier por-

tions of the lecture. Reis has been describing minutely a construction of his apparatus and the mode in which it is to be operated. In these descriptions he does not give the slightest intimation that gentle speech is either necessary or desirable. On the contrary, what he does say would lead one to form an opposite opinion, since one would naturally use a loud tone to produce the circuit-breaking operation which he describes. Moreover, he makes the following specific statement in the paragraph at the bottom of page 541 of the Dolbear record: —

"If now tones or combinations of tones are produced in the neighborhood of the block, so that sufficiently powerful waves enter the opening *a*, then these sounds cause the membrane *b* to vibrate."

The words "sufficiently powerful" appear to indicate that the sounds actuating the transmitter should be loud rather than the opposite.

It would certainly have been natural for Reis, if he considered gentleness of speech to be desirable in using his apparatus, to have stated this when he was describing the mode in which it was to be operated, and not to have made what in the interpretation given to the sentence in your question would be a mere casual and at best very uncertain indication, in a sentence which, as a whole, only calls attention to the fact that certain melodies could be heard by a large assembly, and that precautions were taken to prevent these melodies passing directly to the audience through the air.

Cross-Int. 187. Do you not find in the Böttger article, page 558, the description of this experiment, qualified by the statement that melodies were sung, but not very loudly; and on page 574, in the *Gartenlaube* article, the melody referred to as sung moderately loud; and also in Reis's letter to Ladd, page 563, that *any* sound will be reproduced, if strong enough to set the membrane in motion?

Ans. In the Böttger article referred to, I find this sentence: —

"Into one part of his apparatus located in a building about three hundred feet distant, and having all the doors and windows closed, melodies were sung but not very loudly."

The object of the statement in this sentence as to the loudness of the melodies sung might be to convey either of the two ideas which

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I have considered in my previous answer. Like many of the descriptions and abstracts which are found in publications of the class from which this is taken, some of the clearness of the original is lost in the reproduction. The sentence in Reis's lecture, which I have considered, seems to me to have the meaning which I gave to it. If this sentence in Böttger stood by itself, apart from all other statements, I might give either of the two interpretations to it. Since, however, the present article is simply a notice of Reis's lecture and experiments, undoubtedly abbreviated from the Reis lecture as given in the report of the Frankfort Physical Society for the preceding year, I should naturally interpret Böttger's sentence in the light of Reis's. But it is also clear from the Böttger article alone, that the melodies must be sung loudly enough to cause the circuit to be interrupted, since the operation of the apparatus is thus described, and since the sound was heard by the members in the lecture room.

With regard to the *Gartenlaube* article, the remarks that I have made with regard to the Böttger article apply even more strongly. The *Gartenlaube* article is an article written for popular reading, and, as several sentences indicate, there is no great attempt at accuracy. The sentence referred to in the question is susceptible of either interpretation.

In Reis's letter to Ladd, on page 563, I find this sentence: "*Any* sound will be reproduced if strong enough to set the membrane in motion." As a matter of fact, considering this sentence as it stands alone, and in the light of our present knowledge, it is not true. I suppose that by a sound strong enough to set the membrane in motion, Reis meant strong enough to set the membrane in motion to a sufficient extent to bring about the operation which he describes in the preceding portion of the same paragraph, namely, to lift up the platina foot and thus open the current.

Cross-Int. 188. Do you know of any suggestion or direction in these publications, that the voice must be used with unusual loudness in order that the sounds may be reproduced?

Ans. I do not recollect any specific statement to this effect. I should think that the presence of the speaking tube which is found at the side of the ordinary form of the Reis instrument, and the

conical form of the tube of the transmitter of the Reis-Legat instrument, and the Reis instrument described in the Frankfort lecture, indicated that it was considered desirable to prevent the tones of the voice from acting feebly upon the membrane of the instrument.

Cross-Int. 189. Do you not find also in the Reis lecture, page 543, that he so used the instrument as to transmit complete chords of three tones of a piano, and equally well the tones of other instrum ents, — the accordion, clarinet, horn, organ pipes, etc.; and if so, is it true that it was only capable of transmitting pitch?

[*Objected to for the reason that the only competent evidence of what is in the Reis lecture is the lecture itself and the whole of it; and because the results obtained by Reis in Germany are immaterial; and because his allegations of results are not proof that they were obtained; and because the suggestions made about them are disproved by the rest of the lecture and other publications of Reis relating thereto.*]

Ans. Of course, I can interpret this paragraph only in the light of what Reis says in his lecture, and guided by my own knowledge of the subject discussed therein. I infer from his statements that these sounds were reproduced by using the apparatus as he states that it is to be used, and I think from the context, that these sounds were so produced as to be audible to a large number of persons at once. It is well known that the Reis instrument, when so operated as to break the circuit, will transmit the pitch of the sound but not its quality or loudness; and I infer from this that the tones of the different instruments mentioned had simply their pitch reproduced. As I have already said, when the Reis instrument is operated so as to break the circuit, it will produce a sound loud enough to be heard throughout a large room, but it will not do this if it is so operated as not to break the circuit.

Cross-Int. 190. Does not Reis distinctly declare that "The consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree"?

[*Same objection.*]

Ans. He does.

Cross-Int. 191. Is it necessarily true that if consonants are produced distinctly and vowels not so perfectly, it must be done with-

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out breaking the current; or is it done by making and breaking the current?

Ans. The words "not so perfectly" are very indefinite, and might include almost anything, according to the interpretation put upon them by the person using them. The question of the consonant sounds is a very interesting and at the same time somewhat difficult, one even in acoustics. Some of the consonants are so closely allied that one may be substituted for another without loss of intelligibility, as we constantly observe when a foreigner is using our own language. Also, some of the consonants are explosive in their nature and resemble noises rather than musical sounds. Hence, a circuit-breaking instrument may produce an effect which to an enthusiastic and hopeful inventor will seem tolerably distinct. I do not believe that the consonants could be produced with perfect distinctness, except with an instrument which operates to produce the proper electrical undulations rather than to break the circuit.

Cross-Int. 192. If a Reis instrument can now be so adjusted and used as to transmit speech intelligibly, must it necessarily be so used as not to break the circuit, and so as to produce the proper electrical undulations?

Ans. It must. By this, I mean, of course, that it must not be operated as a circuit-breaker.

Cross-Int. 193. Then if it will transmit speech, it will act by the method of producing electrical undulations, will it not?

Ans. It will.

Cross-Int. 194. Did not Reis (page 542 of the Dolbear record) state that the intensity of the tone is proportional to that of the original one? Can this be true, if, as you have stated (page 113), the intensity is dependent solely upon the power of the battery and the construction of the receiving instrument?

Ans. The statement made by Reis is not true, the intensity of the tones of the receiver not being proportional to the sounds produced at the transmitter. It is quite possible that in certain cases a louder sound at the transmitter might produce, with given conditions of the circuit, a louder sound at the receiver than would be produced by a gentler sound, but there would be no law of proportionality between the two.

Cross-Int. 195. Does not Reis also declare on the same page, that the time during which the circuit remains open has an important bearing upon the results in the receiver?

Ans. He does in the following sentences which I quote:—

"The intensity, also, of this tone is proportional to that of the original one, for in proportion as this is more intense the motions of the membrane are greater; the motions of the hammer, also, and finally the time during which the circuit remains opened is greater, and consequently up to a certain limit, the motions of the atoms in the reproducing wire are greater, we perceiving them as greater vibrations in just the same way as we would have perceived the original sound wave."

It will be observed that Reis is here attempting to explain the physical operation of his receiver. He does not seem to keep in mind the well-known fact that within considerably wide limits the time of vibration is independent of the amplitude. Hence, considering the cut in his lecture (page 541 of the Dolbear case), in connection with his description of the operation of that transmitter, it will appear that the time during which contact will be broken between the contact pieces *b d*, will be the same whether the amplitude of the vibration of the membrane be greater or less. The increased loudness which Reis mentions, whenever it does occur, is, I think, due to a cause which did not occur to him.

Cross-Int. 196. Are you prepared to show by any demonstration that Reis was wrong in stating that the circuit was to a certain extent, sufficient for the purpose he sought, opened during the operation of the instrument, in the manner pointed out by him?

Ans. If I understand the question correctly, I am asked to state whether I am prepared to show that in the experiments in which sounds were transmitted a distance of three hundred feet by his telephone, and made audible simultaneously to a large number of people, his apparatus was not acting as a circuit-breaker. I see no reason whatever to suppose that it did not act as a circuit-breaker.

Cross-Int. 197. My question referred not to the single experiment before a large number of people, but to the operation of Reis's instruments in the manner pointed out by him throughout his publications.

Ans. The only operation that Reis describes is that in which his

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instrument is caused to continually make and break the circuit. see no reason to suppose that he ever intended to operate it in any other way. I do not know exactly the sense which I am to attach to the words "sufficient for the purpose he sought," in your Cross-Int. 196. Reis certainly opened the circuit "too far" to produce certain of the results that he wanted to obtain, such as the transmission of speech, which can only be secured by preventing the contact pieces of the transmitter from parting contact. On the other hand, I see no reason to suppose that he did not habitually cause the circuit to be opened to a sufficient extent to produce those interruptions which he sought to obtain.

Cross-Int. 198. Mr. Storrow, in the report of his oral argument in the Drawbaugh case (page 28, foot of the page), describes the ordinary operation of the telephone transmitter thus: —

"It takes a little time for the contact piece to follow the diaphragm, and while the diaphragm is moving away faster than the weight follows it up, the pressure is relaxed for a moment. The mechanical contrivances which accomplish this are the quick-moving diaphragm and the sluggish anvil electrode. Its weight is what makes it sluggish. If at any moment we have no contact, then we get great trouble; for when there is no contact then we lose all control of the current."

Can you point out exactly how far the anvil electrode must lag behind the quick-moving diaphragm, in order to part them so far that the trouble Mr. Storrow speaks of will be caused?

[*Complainants' counsel objects to the question on the ground that the whole paragraph from the argument should be quoted, if any part of it is to be taken, and further objects to the question as immaterial.*]

Ans. I cannot state any minimum distance, but in no case have I been able to produce a separation so minute that the parting of contact between the electrodes did not produce an effect noticeable in a receiving telephone. With a microphone transmitter various noises are produced, even before the electrodes actually part contact.

Cross-Int. 199. If it takes a little time for one piece to follow the other, must there not be some little, however minute, separation?

Ans. Not necessarily.

Cross-Int. 200. What are the surfaces of contact employed in the Blake transmitter?

Ans. Platinum and carbon.

Cross-Int. 201. About what is the area of the contact portions?

Ans. I do not know what the area is when the transmitter is not in operation. When the transmitter is in operation, this area will, of course, be variable at different portions of the vibration.

Cross-Int. 202. Is it not very small indeed when not in operation?

Ans. It is.

Cross-Int. 203. Is the pressure firm or light?

Ans. Moderately firm, but not at all rigid.

Cross-Int. 204. Can you give some idea of the velocity of the diaphragm when it is at its highest; that is, when at the middle of its path in the ordinary use of the apparatus?

Ans. I cannot do this without making certain calculations and some measurements.

Cross-Int. 205. Is it not very great?

Ans. I do not think it is very great.

Cross-Int. 206. Is it not this motion alone which in the magneto telephone produces the current?

Ans. It is.

Cross-Int. 207. Does not the same velocity exist in the carbon transmitter diaphragm?

Ans. Substantially the same.

Cross-Int. 208. What evidence have you that the anvil piece follows the motion of the diaphragm so as not to allow even the minutest separation between the anvil piece and the diaphragm?

Ans. Before answering this question, I wish to say with regard to my answer to Cross-Int. 198, that it is much more important that the two contact pieces of the Blake transmitter should not part contact than it is that the diaphragm and hammer electrode should not part contact; and I assumed in my answer to Cross-Int. 198 that it was a break of contact between the two electrodes that was referred to as giving trouble. It is, of course, true that it is very desirable to have the hammer electrode and diaphragm always in contact. I also assume that in this question, by the words "minutest separation between the anvil piece and the diaphragm," is meant minutest separation between the anvil piece and the hammer electrode actuated by the diaphragm. Answering the question with this understanding, I

will say that in repeated observation of the operation of microphones of various forms, I have endeavored to see if there were any of the ordinary signs of a rupture of the circuit perceptible in the transmission of articulate speech in the ordinary manner, and I have never succeeded in finding any evidence to lead me to suppose that such a break occurred.

Cross-Int. 209. Have you any other evidence that there is no, even the minutest, actual separation of the contact pieces, as to their physical surfaces, in the ordinary operation of the microphone?

Ans. I have endeavored on various occasions, and with various forms of microphone, to see if any such parting of the contacts could be perceived. I have also made special forms of microphone and arranged them in connection with different electrical instruments in such a way that I think I could not fail to have observed the effect of the minutest actual parting of contact, without detecting any signs of such a separation of the electrodes. In these various experiments, I have found that any parting of contact which I caused to occur, however slight, gave positive evidence of its taking place.

Cross-Int. 210. How many cells of battery are commonly employed with the Blake transmitter?

Ans. One Leclanché cell.

Cross-Int. 211. Supposing the circuit of a Blake transmitter to be continuous, and the loose contact portions to be in contact, how far could they be separated without interrupting the current? In other words, through what distance could a single cell maintain its current through an air break?

Ans. I cannot answer your question as to what would occur with electrodes like those of the Blake transmitter, and I do not know of any experiments which would enable me to answer such a question so far as the Blake transmitter is concerned. Sir William Thomson gives some figures in one of his papers, which would probably give the best published data for an approximate statement on this matter; but I have not his paper at hand, though I will bring it to-morrow, if it is desired.

Cross-Int. 212. Is it not approximately about $\frac{1}{10000000}$ of an inch?

Ans. I do not recollect Sir William Thomson's figures, and of course he does not refer to such electrodes as are used with the Blake transmitter. The distance in dry air under normal conditions of temperature and atmosphoric pressure, across which an electro-motive force of $1\frac{5}{10}$ volts (which is about the electro-motive force of a Leclanché cell) will act, is a very minute quantity, I suppose, of about the order that you mention; but whether it is $\frac{1}{1000000}$ or $\frac{1}{5000000}$ of an inch I should not venture to say, without looking up the best data that I could get hold of.

Cross-Int. 213. Have you any appliance by which you can measure and determine that the Blake transmitter does not habitually break the circuit by a space of the minute order you mention?

Ans. I have never used with the Blake transmitter any micrometric apparatus which would measure so slight a distance, but I think that with some of the microphones that I have used, an actual parting of the electrodes, even through such a minute distance as this, would have given evidence of its occurrence. I have also used certain forms of microphone, the mechanical construction of which is such as to render it almost inconceivable that even such a minute break should occur. In this answer I have assumed that the words "break the circuit," in the question, were equivalent to the words "break of contact of the electrodes," but what I have said is equally true if an actual break in the current is referred to.

Cross-Int. 214. If you have not made any actual measurements of the positions of the contact pieces in the Blake transmitter to determine the fact of non-separation while it is in operation, what satisfactory evidence can you furnish that there is not an actual separation of $\frac{1}{1000000}$ to $\frac{1}{5000000}$ of an inch?

Ans. It is, of course, always much more difficult to show that an obscure and very minute action does not take place, when such is the case, than to show that it does take place if this really occurs, since the former calls for the proof of a negative; but in the absence of strong evidence to the contrary, I see no reason to suppose that the electrodes part contact, even by this excessively minute amount.

The following reasons strengthen me in my opinion, assuming as before that your question refers to parting of contact between the electrodes by a distance so small that the current still continues to flow across the air space : —

1. I see no reason in the mechanical structure and operation of the microphone, because of which such a parting of contact of this minute order should occur.

2. If in the transmission of speech in a low tone such minute separations occur, increasing the loudness by, say, only fifty or one hundred per cent, should produce a perceptible breaking of the current, which does not take place, a much greater increase being necessary.

3. In the known laws of variation of the resistance between the contact pieces with variation in the pressure between them, we have a sufficient explanation of the production of electrical undulations, without any necessity of imagining the occurrence of an actual separation as a necessary or important feature in the transmission of speech.

4. If there were a breaking of the contact of the solid contact pieces through a distance too minute to actually break the current, there would, nevertheless, be a sudden change in the resistance of the joint at the moment when parting of contact takes place. This I should expect to produce an observable disturbing result upon a telephone placed in the circuit.

5. With a microphone in which one of the electrodes weighed about three fourths of a pound, so placed that if a break of contact had occurred, this electrode, which was three inches square and one inch thick, must have been bodily and throughout its whole extent lifted out of contact with the other electrodes upon which it rested, speech is readily transmitted.

6. Besides these well-known facts there are special experiments which I have devised to test this question, which I will describe if desired to do so ; I will not enter upon their discussion otherwise, as this would involve a somewhat detailed description of the theory and operation of my apparatus.

Cross-Int. 215. In your answer to Cross-Int. 76 in the Dirigo case, explaining the difference between the action of what you call

a make-and-break instrument and a Blake transmitter, you say "Setting aside all minor differences, the all-important one is that one actually breaks the circuit, while the other merely varies the strength of the current without ever absolutely interrupting it." Now in what form of so-called make-and-break apparatus have you ever ascertained to a certainty that the current is ever interrupted while it is in its proper operation transmitting speech?

[*Complainants object to the question upon the ground that it purports to state the subject matter to which the answer was directed, and states it incorrectly, because it leaves out of view an important part of said Cross-Int.* 76, *and thereby fails to convey correctly the meaning of the answer to that question.*]

I simply ask in what form of make-and-break apparatus have you definitely ascertained that the current is interrupted while the apparatus is in its proper operation transmitting speech? I do not ask the meaning of your answer in the Dirigo case.

[*Question objected to for the reason that neither the question nor the answer in the Dirigo case, nor any testimony in this case, implies that the current is interrupted while any apparatus is in its proper operation transmitting speech.*]

Ans. In answer to this question, I can only say that I do not know of any make-and-break apparatus which by its proper operation as a make-and-break apparatus is capable of transmitting speech.

Cross-Int. 216. Is not the Reis instrument and the McDonough instrument capable of transmitting speech by some operation?

[*Question objected to because it does not appear what is referred to as "the McDonough instrument."*]

Ans. The Reis transmitter, when used as a microphone and in circuit with a Bell receiver, is, as I know from my own observation, capable of transmitting speech, but not when used as a circuit-breaking instrument. I can better answer the question regarding the McDonough instrument if the particular form of instrument and the arrangement of its different parts are specifically stated to me. Without this I do not feel that it is possible for me to answer the question.

Cross-Int. 217. When the Reis instrument is used as you state and does transmit speech, is the current interrupted or not?

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Ans. It is not interrupted except accidentally and occasionally.

Cross-Int. 218. Does it then operate by the method of causing electrical undulations similar in form to the sound waves accompanying the sounds causing its operation?

Ans. It does.

Cross-Int. 219. If a drop of water had been arranged to drip on the contact point in the Reis-Legat or other Reis transmitter, would it not have caused the current to be so kept as to make it undulatory in the sense in which you use the expression?

Ans. I have never tried this experiment, and so do not know from my own observation what results would actually occur. If, however, there was an alternate making and breaking of contact between the solid electrodes with simply a drop of water between them, I should suppose that even though the current continued to flow, there would be marked electrical pulsations whenever the contact of the solid electrodes was made or broken, so that the effect of these pulsations would be superposed upon the effect due to such electrical undulations as would be produced by a variation of the electrical resistance of the liquid between the electrodes while these were out of contact.

[*Adjourned.*]

JUNE 19, 1885.

Cross-Int. 220. Will not three blocks of carbon make a successful transmitter, when two of them are joined to the line in such a way that the third, by simply resting upon them, closes the circuit?

Ans. Yes.

Cross-Int. 221. What is the force acting to keep the third piece in its place, and prevent a break of the circuit?

Ans. The weight of the upper piece. Also, if the surfaces are polished and pressed closely together, the pressure of the atmosphere and perhaps the adhesion between the surfaces is effective.

Cross-Int. 222. Are not these causes operative upon the loose contact pieces of the Reis transmitter?

Ans. The first of these is.

Cross-Int. 223. In the case of these three blocks being used, would you employ the voice with such explosive force as to make them jump and part company to any appreciable extent?

Ans. I certainly should not attempt to do this if I desired to transmit speech with any microphone; and I do not think that I could cause the blocks to part company even by the utmost exertion of my voice.

Cross-Int. 224. With the same desire, cannot the Reis transmitter be used with similar care?

Ans. I have succeeded, with care, in transmitting speech by the Reis transmitter, using in connection with it a Bell magneto receiver.

Cross-Int. 225. When the Reis transmitter thus transmits speech, or when any microphone transmitter does so, or ever has done so, is it, in your opinion, done by causing electrical undulations similar in form to the air waves accompanying the sounds used to put it in operation?

Ans. All of the transmitters which I have ever seen, when transmitting speech, have done this in the manner mentioned in your question.

Cross-Int. 226. The question is whether, in your opinion, it must be so as a scientific fact?

Ans. I do not know of any other method than this.

Cross-Int. 227. Suppose two conducting surfaces in contact and a current flowing from the one to the other through this contact, and suppose now an act of separation between the two produced in any way and by any means; must there not be a change in the resistance, so that it gradually increases from that which it first had up to the limit where it becomes infinite?

Ans. There is, of course, a continued increase of resistance up to infinity, but it is difficult for me to understand the sense which you attach to the word "gradual." What actually occurs when the contact pressure between two electrodes is diminished is this: Beginning with a moderate pressure, and diminishing this pressure continuously and at the same rate, the resistance increases, at first slowly and in proportion to the diminution of pressure. As the pressure between the electrodes becomes less and less, the increase of resistance becomes proportionally more and more rapid, so that the rate of change of resistance with variation in pressure becomes greater and greater as the pressure becomes less and less. It is

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possible to keep the two electrodes in contact and still have so great a resistance between them that this might be said to be practically infinite, yet even under these circumstances an actual passage from this enormously great resistance to the resistance interposed by a thin film of air is distinctly perceptible in a telephone placed in the circuit.

It should be remembered, although this is very frequently forgotten, that the meaning of an infinite resistance in a conductor, and of an infinite resistance offered by a non-conducting film of air, is neither mathematically nor physically the same. If you suppose the gradual increasing resistance of a microphonic contact up to infinity to be represented by a curve, this curve will be continuous indefinitely. If you suppose a rupture of contact to take place so that absolutely no current passes, in which case the resistance may be said to be infinity, there will be a sudden and final break in the curve at that point. Physically, the meaning of the term "resistance," applied to a thin film of air, is very different from its meaning as applied to a conductor. There are numerous phenomena of polarization and other obscure actions, which come into play as soon as the physical contact of the solid electrodes is broken.

Cross-Int. 228. Will not the current go through corresponding changes in intensity in substantial accord with what we know as an undulation, provided the current be renewed in the reverse order by renewing the contact, which at first must be indefinitely or infinitely small and rises gradually to the former maximum by the action of gravity or some other force similar to that which caused the diminution or total exhaustion of the current?

Ans. If I understand the question correctly, it refers to the changes which take place in a circuit containing a Reis transmitter or some other circuit-breaking instrument, or a microphone so operated as to actually break the circuit at each principal vibration, together with some telephone receiver.

The electrical phonomena in such a circuit are necessarily very complicated, because there are not only those changes in the original battery current which are due to the diminution of pressure between the electrodes and the final parting of contact between them, but also those variations (which when the circuit is broken become

extremely great) caused by the extra current which is due to the self-induction of portions of the circuit. Neglecting altogether the effect of the extra current, the curve representing the variations in the electric current corresponding to the motions of the circuit-breaker would be represented by a sinuous line broken at each crest for a distance greater or less in proportion to the time during which the circuit is open. This sinuous line, even in its continuous portions, would deviate to a certain extent from the curve representing the air waves actuating the transmitter, on account of the disproportionately rapid diminution of current in proportion to the diminution of pressure when the breaking point is approached.

If now we consider the action of the extra current, the phenomena become far more complicated. This extra current, as is well known, is proportional to the rate of change of the strength of the primary current. With an ordinary microphone so operated that it shall not closely approach the breaking point, the effect of the extra current, under ordinary circumstances, is inconsiderable; but with a circuit-breaker, in a very minute fraction of a second, the resistance changes a slight amount to an absolutely infinite quantity (or the reverse), so that the extra current is very strong, as indeed is shown by the sparks which are produced at the moment when the circuit is ruptured.

If we consider the acoustic effect produced in the receiving instrument, the disturbances caused by the rupture of the circuit are even greater than the electrical disturbances; for all of these disturbances, of course, affect the diaphragm or other vibrating part of the receiving instrument, and in addition to this, whenever there is an actual gap in the current, the diaphragm of the receiver tends to assume its own particular rate of vibration, which, of course, introduces additional disturbance.

Cross-Int. 229. You say that you have succeeded in transmitting speech with a Reis transmitter connected with an ordinary Bell receiver; while so used you would not apply the term "circuit-breaker" to it, would you?

Ans. If I were describing this operation especially, I should not call the apparatus a circuit-breaker, unless I explained particularly that I used that term merely as an ordinary name for such an

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instrument, just as I might refer to a Morse signal key, if I were using it as a microphone. I should say of any such circuit-breaking apparatus that I so operated it as not to break the circuit; though I might still call it a circuit-breaker for brevity's sake, using this merely as the name for an instrument, without reference to the particular and abnormal use to which I was putting it.

Cross-Int. 230. It does not actually break the circuit during such use, does it?

Ans. Not if it operates solely as a microphone.

Cross-Int. 231. Then does it become a circuit-breaker in fact, as well as in the name you apply to it, by using the voice more violently upon it?

Ans. If the voice is used with sufficient violence, the circuit is, of course, broken at intervals. If, notwithstanding this periodic interruption, the instrument produced any effect which was due to an operation going on while the circuit remained unbroken, and to which the actual rupture of the circuit was either harmful or not essential, I should say that as far as the use of the word in telephony is concerned, the instrument would not be in fact a circuit-breaker. Under these circumstances, the real function of the apparatus would not be to break and make the circuit, but to perform some other operation during the time when the circuit was closed.

Cross-Int. 232. Do not the same remarks apply to the defendants' instrument and the Blake transmitter? Are not they also capable of being used so violently as to break the circuit?

Ans. They are.

Cross-Int. 233. With the ordinary arrangements of the loose contact transmitters, say the Blake, is not the motion of the contact pieces relatively different in velocity?

Ans. It is.

Cross-Int. 234. This being so, would they not become indefinitely separated, provided their motion of recession were sufficiently prolonged at any one time?

Ans. They would.

Cross-Int. 235. Just how far might this act of separation be carried in the ordinary use of the apparatus without producing absolute discontinuity of the circuit?

Ans. I cannot say.

Cross-Int. 236. If the pitch of the sound and its amplitude, together with the mass of the suspended contact piece, as well as the piece attached to the diaphragm of the transmitter, and also the elasticity of the diaphragm were given, is it not possible to calculate the amount of separation that must occur in a given case?

Ans. I do not think that it is possible from these *data*.

Cross-Int. 237. Do you think that the diagram given by Bell, representing an interrupted current, showing sharp angles (found on page 642, among defendants' exhibits in the Molecular case), can correspond to any current which you can produce by any means whatever?

Ans. If you consider this as representing exactly and minutely the total electrical changes in the wire, I do not suppose that it would be possible to obtain such a curve. I do not understand that the figure referred to is intended to give more than a general idea of the nature of the variations in the electrical current.

Cross-Int. 238. Can currents be set up "instantaneously"?

Ans. It of course requires a certain, although it may be an almost inconceivably minute, time for a current to attain its maximum strength in a conductor.

Cross-Int. 239. In the loose contact between the carbon and the platinum of the Blake transmitter, for example, do not the laws of mechanics necessitate a separation when the moving force is suddenly applied to one member, the diaphragm, before the other can acquire the same velocity?

Ans. They do not.

Cross-Int. 240. From the known number of vibrations constituting a vowel sound employed in common conversation, and from the known great velocity of electrical transmission, is it not clear that when such sounds are sent telephonically, there will be relatively long intervals in which the line will be free from electrical disburbances?

Ans. This will not be the case.

Cross-Int. 241. Have you read the article of L. de Locht-Labye

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from *La Lumière Électrique*, a translation of which appears in the *Scientific American* supplement, No. 490, May 23, 1885?

Ans. I have not.

Direct Examination continued by J. J. STORROW, Esq., *of Counsel for Complainants.*

Int. 242. You have been asked about a contrivance or arrangement of tuning-fork circuit-breakers, tin box, and electro-magnet, which you and Prof. Pickering had used; and about a deposition which you gave in 1879, which, and a copy of which, have been produced and put in evidence. Will you please state what invention or alleged invention the facts stated in that deposition were intended to meet or anticipate?

Ans. I understood at the time that the experiments were called for in my deposition, because the apparatus antedated an apparatus which Mr. Elisha Gray had patented, in which there was a metallic plate opposite the poles of an electro-magnet, which plate was set into vibration by the action of a circuit-breaking tuning-fork, a form of harmonic telegraph by which musical sounds were produced at the receiver by these interruptions of the circuit.

I understood that Mr. Gray found subsequently to Mr. Bell's invention of the speaking telephone, that his receiving apparatus could be used as a speaking telephone receiver by using the method of producing and employing electrical undulations invented by Mr. Bell. I found on experiment that the apparatus which I had described in my 1872 lecture, which was previous to the experiments of Mr. Gray, was also capable, when used as a receiver in connection with a transmitter employing the method devised by Mr. Bell, of acting as a speaking telephone receiver.

Int. 243. Will you please designate the different receiving instruments of Mr. Gray, which you referred to in your last answer, by the names by which they have commonly been known in telephone litigation since the Bell patent?

Ans. I mean those instruments which have been called the "wash basin," the "tin-dipper," and the "blacking-box" receivers respectively. I understood that some of these instruments had been patented, but not which particular ones.

Int. 244. Referring now to the contrivance which you or Prof. Pickering rigged up, consisting of a sonometer circuit-breaker or tuning-fork circuit-breaker at one end of your laboratory line, connected with an electro-magnet and tin box at the other, will you please state whether that apparatus as a whole was or was not used for the transmission of speech, or intended for the transmission of speech?

Ans. The apparatus was neither used nor intended to be used for the transmission of speech.

Int. 245. State whether it was by construction adapted for the transmission of speech.

Ans. It was not at all adapted for the transmission of speech, and as a whole was quite a different apparatus from what any one familiar with physics would have devised for transmitting speech.

Int. 246. Will you state whether the sounds which you intended to produce and did produce by it were caused by interruptions of current, or by electrical undulations similar in form to sonorous air vibrations produced at the transmitting station?

Ans. They were produced entirely by interruptions of the current.

Int. 247. Will you state whether the apparatus was actuated, or intended to be actuated, by sound waves produced at the transmitting station?

Ans. It was not.

Int. 248. Please state briefly what knowledge you had in 1872 about the Reis apparatus and its mode of operation, and what attention you had given to its merits or demerits.

Ans. Since giving my answer to Cross-Int. 49 in this deposition, I have looked over all of the books bearing upon the subject which I had in my possession or would have referred to previous to my 1872 lecture, and in which any description of the Reis telephone is to be found. The only description which I can have read previous to that time is the notice of the instrument given in Koenig's Catalogue of Acoustic Apparatus, and which is found translated on page 581 of the Dolbear record. This was all that I knew about the apparatus, and if I had heard anything from other sources, I learned nothing beyond what is given in this statement. I understood that

it was not a success for the transmission of speech, and that it was very imperfect for the transmission of any sounds. I had not studied its operation minutely, nor had I reached any opinion as to why it was so inefficient. We had in our collection of apparatus the Wertheine coil and core, which is substantially the Reis receiver. I should say that to the best of my recollection, I thought of the Reis receiver as being electrically imperfect, rather than the transmitter, but did not consider the subject very seriously.

[*Adjourned to Monday, June 22, at 10.*]

JUNE 22, 1885.

Int. 249. Referring to your last answer, will you state how seriously you had then considered the subject of the Reis transmitter, and what could or could not be done by the mode of operation attributed to it?

Ans. So far as I can ascertain, my whole knowledge of the Reis apparatus did not exceed what is given in Koenig's catalogue. Since making my preceding answer, I have carefully looked over my manuscript notes, which are exceedingly full, of all the lectures on acoustics which I had then heard, and I cannot find in them any reference to the Reis apparatus. I knew that the apparatus was on the whole a failure, and was, of course, familiar with Koenig's statement as to the difficulties which were found in the operation of the transmitter, having had a copy of his catalogue in my possession for several years. I saw an acoustic difficulty in the Reis transmitter, as I thought that the membrane would not take up all of the sounds which were produced in the air. Having recognized this difficulty, I did not consider further the matter of the perfection or imperfection of the Reis transmitter.

[*Complainants put in evidence a copy of the article in Koenig's catalogue about Reis, printed in the Dolbear record, page* 581.]

From KOENIG'S "Catalogue des Appareils d'Acoustique," Paris, 1865, page 5.

"29. TELEPHONE OF M. REIS. 60 FR.

"This apparatus is intended to transmit sounds to a distance by means of electricity. It rests upon the fact demonstrated by the preceding apparatus. [*The preceding apparatus was the Wertheim coil and core, which Reis uses for a receiver.*]

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"At the first station the current traverses a little band of platinum, which is attached to a membrane in such a way as to follow all its movements, and of a very movable point which rests lightly upon this membrane. At the other station the current traverses a coil, at the centre of which is a bar of soft iron. If now, we produce before the membrane a sound which causes it to vibrate, each vibration in pushing away the point from the platinum plate will produce an interruption of the current. On the other hand, each meeting of the current will produce in the bar of soft iron at the second station, a momentary and weak sound. It is the rapid and isochronous succession of these sounds, all acting as simple blows, which produces the continuous sounds that are heard. It is true that they are not of good quality, and that they cease from time to time. This comes from the fact that the membrane does not vibrate equally well for all tones, and because the manner in which the vibrations determine the interruption of the current by pushing the little point away from the plate, is far from being perfect."

Int. 250. What views did you then entertain about the tin packing box which you used as a receiver, as compared with the Reis knitting-needle receiver, or such modification of it as you had at the Institute in what you call the Wertheim core and coil?

Ans. From the large surface of the plate and its known capacity of vibrating in many different ways, I inferred that the apparatus ought to make a better receiver than that of Reis. It seemed to me to be much better adapted to reproduce vibrations in general than was the Reis knitting-needle receiver.

Int. 251. You were asked on cross examination about a statement which you made in a lecture about February, 1872. Will you please tell us what that statement was, and what led you to make it?

Ans. The lecture was delivered at the time that preparations were in progress for the Peace Jubilee, as it was called, which was held in the summer of that year, and some of those present were interested in that exhibition. After exhibiting the tin-box apparatus, I remarked that by a modification of the transmitter it would be possible to transmit the music of the jubilee to different portions of the country, so that the audience need not come to the concert room. I also suggested that the singers might remain at their homes and their music be transmitted, and that it might be possible to transmit speech over the country.

Int. 252. Did you suggest or know of any means, method or apparatus by which that could be done, and if so, what?

Ans. I did not. The only transmitting apparatus which I had in mind was the Reis transmitter, if the difficulties which I understood were met with in operating it could be removed. My only definite thought was with regard to the receiving apparatus.

Int. 253. Did you have any ideas as to how those difficulties could be removed, or did your mind consider that subject?

Ans. I did not have any definite ideas. According to the best of my recollection, the difficulty seemed to me, as far as I had considered it, to be the acoustic one that I have mentioned. Beyond this, I did not consider the subject.

Int. 254. When and from whom did you first hear of the idea of creating and employing electrical undulations corresponding to sound waves as a means for transmitting speech by electricity?

Ans. From Mr. Bell. It was in the autumn of 1874, according to the best of my recollection.

Int. 255. Did he at or about that time, and during that fall or winter of 1874–5, state to you anything concerning the structure of the instrument which he proposed to employ in the transmission of speech, upon this plan?

Ans. I understood that he wished to produce electrical waves which should be like sound waves in their form as well as in their number. These were to be produced in some way by vibrating a piece of iron in front of the pole of a magnet.

Int. 256. Did he tell you how he proposed to vibrate this piece of iron, and by what kind of a contrivance?

Ans. As far as I can recollect, he proposed to set a membrane in vibration by the voice and have the membrane actuate the piece of iron.

Int. 257. Did you form any opinion at that time as to the theoretical perfection or imperfection of that plan for the transmission of speech?

Ans. I thought that the instrument was theoretically perfect, but did not suppose that it would produce vibrations which would be strong enough to produce any effect on a receiver.

Int. 258. When did you first try or see any one else try to trans-

mit speech by electricity, and whose instrument was it that was tried?

Ans. In the spring of 1876, when Mr. Bell exhibited his telephonic apparatus at a meeting of the Society of Arts at the Institute of Technology. I first saw the apparatus on the afternoon preceding his lecture, which was given in the evening.

Int. 259. When you used that packing box, which you described on your cross examination, with the circuit-breaking tuning-fork, how much battery power did you apply to produce its vibrations?

Ans. Six Grove cells.

Int. 260. When and how did you first come to believe that that packing box and magnet could produce audible and distinguishable articulate sounds under the influence of articulating electrical undulations, such as are produced by a good microphone?

Ans. In 1879, when I first tried it, as I have described in my deposition in the Harmonic Telegraph case. I had previously doubted whether the electro-magnet and box which I used were capable of reproducing speech with such currents as are given by a magneto telephone or a Blake transmitter, on account of the large size of the magnet and box; and I remember remarking, soon after the invention of Prof. Bell's magneto-receiver with an iron plate, that Prof. Pickering and I had been going in the wrong way in increasing the size of our apparatus.

Int. 261. Will a large magnet and plate produce stronger and better or weaker and worse articulation under the influence of such currents than a small magnet and plate?

Ans. The articulation will be weaker and less distinct.

Int. 262. If you take exactly the apparatus and arrangement which you had when you used that box, as stated in your cross examination, can you or can you not, by the application of Mr. Bell's method or any other that you know of, and with the aid of all your present knowledge and experience, transmit articulate speech by talking to the transmitter and listening at the receiver?

Ans. Since the last day of my deposition, I have set up the original apparatus, using the same box, electro-magnet and forks that I used in my experiments of 1872 and 1873. I used six cells of Fuller battery, which is, electrically, substantially equivalent to the six Grove cells of my early experiments.

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With those forks which I used in 1872, I used, as then, styles of brass forming one electrode, and dipping into a cup of mercury to complete the circuit. With another fork which I used in 1873, I employed a platinum style. I placed the magnet, in my experiments with each fork, opposite the bottom and also opposite the end of the box. I placed the magnet, in the experiments with each fork, at the distance from the box at which it gave the best results as to loudness of sound, when the fork was employed as a circuit-breaker; and I also placed the electro-magnet as close as it could be placed to the plate, without having the plate drawn into contact with the poles of the magnet through their attraction upon it. I tried very carefully with all of these adjustments to transmit speech by having a second person speak and shout loudly to the tuning-fork transmitter, while I listened attentively in a quiet room, and with my ear close to the receiving instrument to hear any sound which might be transmitted. I did not hear any speech or sound of the voice whatever with any of the forks. Most of the forks of the transmitter I adjusted myself, as I have always been in the habit of adjusting such circuit-breaking forks, with the brass or platinum electrode carried by the fork dipping by a very slight amount beneath the surface of the mercury when the fork was not in vibration.

Int. 263. In the experiment just referred to, did you or did you not aid yourself by a telephone telltale line between the two stations, and cause the whole operation to be conducted in the way best calculated to obtain speech from such an apparatus, according to your present knowledge and experience?

Ans. I did make use of a telltale line as an aid in adjusting and operating the apparatus. I also did my best with my present knowledge to obtain a transmission of speech by means of the apparatus.

Int. 264. Will you please refer to the Reis lecture, mentioned in your answer to Cross-Int. 185, and if you find in it any specific statement as to whether, in the apparatus of Reis there described, the electrodes part contact and interrupt the current, will you please read it as part of your answer?

Ans. I find in the Reis lecture the following statement: —

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[EXTRACT FROM REIS'S LECTURE.]

"If now tones or combinations of tones are produced in the neighborhood of the block, so that sufficiently powerful waves enter the opening *a*, then these sounds cause the membrane *b* to vibrate. At the first condensation the hammer-like wire *d* is pushed back; at the rarefaction it cannot follow the retreating membrane, and the current traversing the strip remains broken [Strom bleibt so lange unterbrochen bis, *etc.*], until the membrane forced by a new condensation again presses the strip (proceeding from *p*), against *d*. In this way each sound wave causes a breaking and closing [ein Oeffnen und ein Schliessen] of the current [Stromes].

"At each closing [Schliessen] of the circuit [Kette] the atoms of the iron wire inside the distant spiral are moved away from each other (Pouillet Müller, page 304, Vol. II., fifth edition); on breaking the circuit [beim unterbrechen des Stromes], these atoms seek to regain their position of equilibrium. When this happens, in consequence of the reciprocal actions of elasticity and inertia, a number of vibrations are produced, and they give the longitudinal sound of the rod (see as above). This is the case if the making and breaking of the current [Unterbrechungen und Schliessungen des Stromes] occur with comparative slowness. If they occur more rapidly than the oscillations of the iron core, due to its elasticity, the atoms cannot complete their course. The paths described become shorter in proportion as the interruptions are more frequent, but then are just as numerous as these.

"The iron wire no longer gives its longitudinal (normal) tone, but a tone whose pitch corresponds to the number of interruptions [Unterbrechungen] (in a given time); this is the same as saying that *the rod reproduces the tone* [ton] *impressed upon the interrupter* [dem Unterbrechungs apparat].

Int. 265. Please answer the same question as to the Böttger article and the Gartenlaube article referred to in answer to Cross-Int. 187, page 558.

Ans. I find in the articles inquired about the following passages: —

[EXTRACT FROM BÖTTGER'S ARTICLE.]

"As is known, tones are produced by the rapid succession of condensations and rarefactions of the air. If the vibrations of the air, called waves, strike the thin membrane, they push the same against the strip of platina that touches it, and then allow it to immediately vibrate back into the hollow cube (called the artificial ear), and so cause the membrane to assume forms alternately bent towards the cube and from the same. The strip of platina lying against the

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membrane is thus set into a swinging motion, so that it is alternately pressed on to the platinum point of the second strip and then leaves the same.

"If one of the strips is connected by a wire to one of the poles of a voltaic battery, and the electricity is conducted to any desired distance by a wire connected to the other pole, and is then carried through a helix six inches in length, wound with six layers of thin silk-covered copper wire, and from there is carried back to the second strip of platina on the wooden cube by means of an insulated wire, then at every vibration of the membrane, an interruption of the current of electricity [Unterbrechungen der Stromung der Electricitat] will be caused, as the point on the one strip of platina no longer touches the other strip. Through the hollow of the spiral a thin iron wire (a thick knitting needle), about ten inches in length is passed, so that it projects out of each end of the spiral about two inches, and these projecting ends each rest on a bridge of a sounding board.

"It is known that if an electric current is passed through a helix that surrounds an iron wire, at every interruption a tone produced by the vibrations of the iron wire is audible. If the makings and breakings of the current [Unterbrechungen des Stromes] follow each other rather slowly, the different positions (in regard to the length of the bar), which the molecules will be caused to assume by the electricity will produce a tone, its so-called proper longitudinal tone, which depends on the length and thickness of the bar or wire.

"If the interruptions and reconnections of the current [Unterbrechungen des electrischen Stromes] in the spiral takes place faster than the vibrations of the smallest parts of the wire, which in turn depends upon the elasticity of the wire, they cannot complete their course, receive new shocks; the vibrations get to be smaller but more rapid, and as numerous as the interruptions follow each other. The piece of wire no longer gives its longitudinal tone, but a tone which, according to the number of interruptions in a certain time, is higher if they are more frequent and lower if they are less frequent. It is known that the pitch of a tone depends on the number of air waves that follow each other in one second. We have seen that the number of interruptions of the electric current [Unterbrechungen des electrischen Stromes] by the membrane and the strips of platina is dependent upon this. Consequently, the iron wire must give a tone of the same pitch as the sound which was received by the membrane. As electricity is hardly impaired when conducted a great distance, if the proper apparatus is used, it is evident that a tone acting on a membrane in one place can be made audible at any desired distance by the iron wire."

[EXTRACT FROM *GARTENLAUBE* ARTICLE.]

"Although for the present we are not so far along as to be able to converse with a friend at a distance of several hundred miles, so

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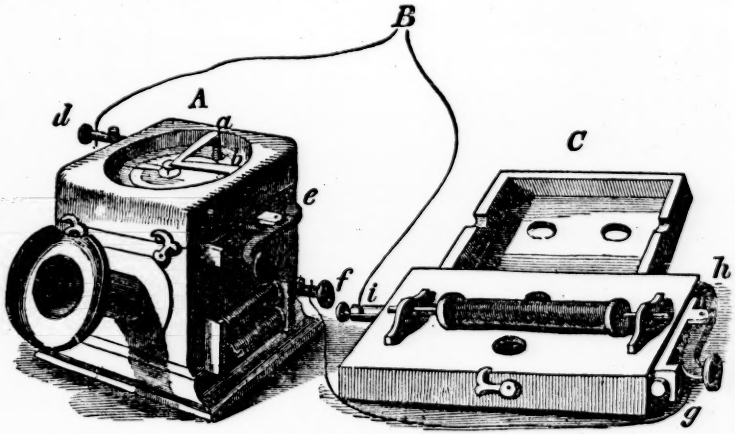
much, at least, is certain, that with the aid of the telephone, songs of all kinds, melodies, especially in the middle registers, can be reproduced most clearly at unlimited distances. These wonderful results are obtained with the following simple apparatus, which we show here in one fourth of its size : —



"A small box A (the telephone proper), a kind of hollow cube, has a mouthpiece S on the front side and a somewhat smaller opening on the upper side of the box. The latter is closed with a fine membrane (skin from the intestines of a hog), tightly stretched. A narrow strip of platina *m*, connected with the screw post *d*, touches directly the membrane on its centre; a slender platina point *k* attached to the angle *a b* touches the strip of platina which rests on the membrane. If one sings into the mouthpiece S (by filling the same entirely with the mouth), the thin membrane vibrates, and the attached platina strip receives likewise a vibrating motion, so that it is alternately pressed against and leaves the platina point *k*.

"From the binding post *d*, which communicates with the platina strip resting on the membrane, a conducting wire is connected with one of the poles of a galvanic battery B (about three to four six-inch Bunsen elements), and then the electricity is led through a wire attached to the second pole of the battery to the distant station C; there at *i* it passes through a coil *l l*, formed of copper wire covered with silk thread, then back again to screw *f*, and there to the platina point *k*. At every vibration of the membrane, an interruption of the electric current [Unterbrechung des electrischen Stromes] takes place by the platina point parting from the platina strip.

"Within the wire coil at station C is a thin iron wire (a strong knitting needle), which is about ten inches long, and which with its two ends projecting out of the coil for about two inches, each rests on two bridges of a sounding box. This is the *reproducing* apparatus.

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"At every interruption of the current [Unterbrechung des Stromes] in the coil, the iron rod is made to vibrate. If the motions follow with a certain rapidity they produce a tone which is rendered audible by the sounding box. As the rate of the interruptions depends on the pitch of the tone that has been sung into the mouthpiece, the same tone is sounded with the same pitch from the sounding box."

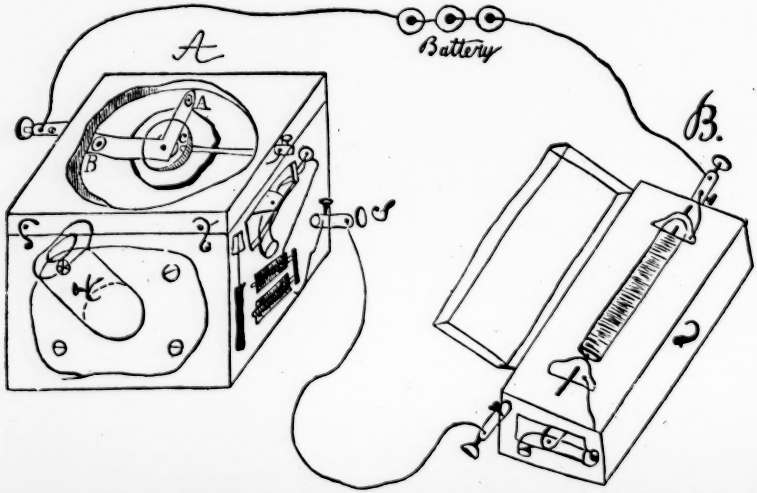
Int. 266. Please answer the same question as to Reis's letter to Ladd, referred to in your answer to Cross-Int. 187.

Ans. I find in the letter inquired of, the following: —

[EXTRACTS FROM REIS'S LETTER TO LADD.]

"It was no hard labor either to imagine that any other membrane beside that of our ear could be brought to make similar oscillations, if spanned in a proper manner and if taken in good proportions, or to make use of these oscillations for the interruption of a galvanic current. However, these were the principles which guided me in my invention; they were sufficient to induce me to try the reproduction of tunes at any distance. It would be long to relate all the fruitless attempts I made until I found out the proportions of the instrument and the necessary tension of the membrane. The apparatus you have bought is now what may be found most simple, and works without failing when arranged carefully in the following manner:—

"The apparatus consists of two separated parts, one for the singing station A, and the other for the hearing station B.



Reis's Telephonic Apparatus.—Facsimile of Drawing sent by Reis to Mr. Ladd.

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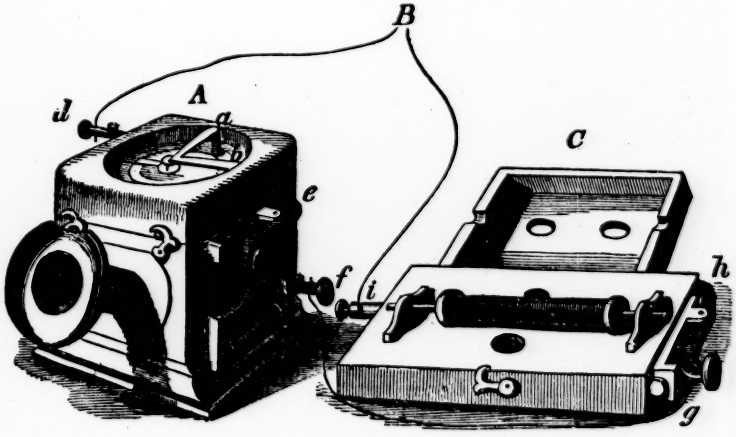
"If a person sing at the station A, in the tube x, the vibrations of air will press into the box and move the membrane above, and thereby the platina foot c of the movable angle will be lifted up, and thus will open the stream at every condensation of air in the box. The stream will be re-established at every rarefaction. In this manner the steel axis at station B will be magnetic once for every full vibration, and, as magnetism never enters nor leaves a metal without disturbing the equilibrium of the atoms, the steel axis at station B must repeat the vibrations at station A, and then reproduce the sounds which caused them. *Any* sound will be reproduced if strong enough to set the membrane in motion."

Int. 267. Please answer the same question with regard to Reis's descriptive circular, Aug. 9, 1863, printed in Dolbear record, page 568.

Ans. I find in Reis's circular the following statements: —

[REIS'S DESCRIPTIVE CIRCULAR.]



"The apparatus consists of two parts, as may be seen in the wood cuts above, the telephone proper A, and the reproducing apparatus C. These two parts are to be placed at such a distance from each other that singing or the sound of a musical instrument can be heard in no other manner, except through the apparatus from one station to another.

. . . . . .

"If now sufficiently strong tones are produced before the mouthpieces, their vibrations will put in motion the membrane and the angular little hammer [winkelförmige Hämmerchen], which lies on it; for every full vibration the circuit is once opened and again

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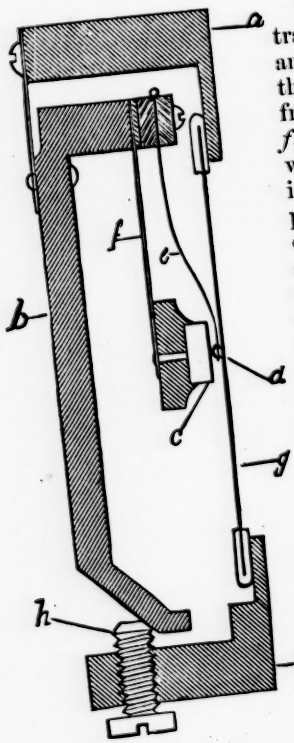
closed [einmal geöfnet und wieder geschlossen], and thereby are produced at station C in the core of the coil, just the same number of vibrations [ebensoviele Schwingungen hervor-gebracht] which are there perceived as tones or as combinations of tones [accords]."

[*Complainants* de bene, *and referring to* **Cross-Int.** 198, *put in evidence the whole paragraph, from which an extract is given, as follows:* —]

[EXTRACT FROM MR. STORROW'S ARGUMENT.]



"The instrument I now show, the Blake transmitter, the one in commercial use, is an instrument of that kind. This cut shows the principal operating parts. The current from one pole of the battery is brought to *f*, which is a spring, passes to the block *c*, which is of hard carbon, — black in the instrument, — then to the little knob of platinum *d*, about as big as a pinhead in contact with it; then through the delicate spring *e* to the distant station, and back to the other pole of the battery. I omit reference to the induction coil, which has nothing to do with my present explanation. The carbon *c*, and the knob *d*, are not fastened together, but merely held in gentle contact by the springs *f* and *e*, but the whole current has to pass through that contact. The knob *d* lies against the diaphragm *g*. If, now, by speaking into the mouthpiece against the diaphragm from the direction *g* (the mouthpiece being omitted in the cut), that diaphragm is made to vibrate; then, on each particular vibration, it is pushed back and pulled in again, — it is not a slow push, such as I gave with my pencil; it is an extremely sharp, quick push, because it has to pass from one end of its motion to the other, as I am speaking now, in about the two hundredth part of a second, — a quick, sharp push. Before this back electrode, or anvil electrode *c*, as we call it, can get out of the way, the little knob on the diaphragm, which presses against it, gets squeezed in the process. If you hang up a sand bag, and strike it with your fist, there is a sensation of pressure on your fist, and that is just what takes place here. In the next movement, when the diaphragm comes back

again towards g, that heavy weight will follow it by the force of the spring, but owing to the inertia due to the weight, it will not come quite so quick as the diaphragm. It takes a little time for it to follow, and while the diaphragm is moving away faster than the weight follows it up, the pressure is relaxed for a moment. Now, this instrument, — and there are others, but this is the one in the ordinary use, known as the Blake transmitter, — is so contrived that the pressure will be thus alternately increased and relaxed. The mechanical contrivances which accomplish this are the quick-moving diaphragm and the sluggish anvil electrode which carries the carbon. Its weight is what makes it sluggish. It weighs about seventy-five grains. If, at any moment, we have no contact, then we get into great trouble; for when there is no contact we lose all control of the current. All control ceases. When we get a flowing current we can control it, and by it can control the receiver. What we have to do is to vary the current without interrupting it, and that apparatus is an apparatus which will do it."

Int. 268. Suppose you take the defendants' microphone, or any other good microphone arranged and adjusted for ordinary commercial use, and speak to it as such instruments are ordinarily spoken to in practice; will you get speech from the connected receiver, or will you not?

Ans. You will get speech.

Int. 269. Suppose that to the Reis instrument constructed as directed by Reis, arranged to perform the operation expressly described by Reis, you speak in the same way that you spoke to defendants' transmitter in the last answer; will you get articulate speech or not, from any connected receiver?

Ans. You will not.

Int. 270. Will there be any difference in the mode of operation or behavior of the two electrodes towards each other in the case of one instrument from that which occurs in the other; and if so, what will be the nature of that difference, and what relation will it have to the difference which occurs in results?

Ans. In the defendants' transmitter, the action of the air waves will produce such variations in pressure between the electrodes as I have described, so that by microphonic action electrical undulations will be produced, and articulate speech will be obtained from the receiver.

In the Reis transmitter, the action of the air waves will be to

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cause violent interruptions in the current, so that for reasons that I have already stated, articulate speech will not be obtained from the receiver.

Int. 271. If there are any features of mechanical construction in the instruments which tend to make one vary the pressure without interrupting the current, and tend to make the other interrupt the current, will you please mention some of the most prominent ones.

Ans. In the defendants' transmitter, the mass of the anvil electrode and the normal pressure existing between the two electrodes is considerable, this being a well-known mechanical advantage in preventing breaks of the circuit, and producing variations in pressure.

In the Reis transmitter the anvil electrode is very light, and the normal pressure between the electrodes very slight, which mechanically favors greatly the production of interruptions.

The materials of which the electrodes of the defendants' transmitter are composed, namely, carbon and platinum, are well adapted to ensure the production of electrical undulations, and are not well adapted to produce interruptions of the current.

The material of the electrodes of the Reis transmitter, — platinum, — is well fitted to produce interruptions of the current, but is very poorly fitted to produce such electrical undulations as are utilized in the transmission of speech.

Int. 272. Prof. Hughes wrote two articles in 1878 concerning an apparatus which he produced and called a microphone; the second one of those was read before the Physical Society, at London, June 8, 1878, and is entitled "On the Physical Action of the Microphone." In it I find the following: —

> The problem which the microphone solves is this: To introduce into an electrical circuit an electrical resistance, which resistance shall vary in exact accord with sonorous vibrations so as to produce an undulatory current of electricity from a constant source, whose wavelength, height, and form shall be an exact representation of the sonorous waves. In the microphone we have an electric conducting material susceptible of being influenced by sonorous vibrations, and thus we have the first step of the problem.
>
> The second step is one of the highest importance. It is essential that the electrical current flowing be thrown into waves of determinate form, by the sole action of the sonorous vibrations. I resolved

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this by the discovery that when an electric conducting matter in a divided state, either in the form of powder, filings, or surfaces, is put under a certain slight pressure, far less than that which would produce cohesion, and more than would allow it to be separated by sonorous vibrations, the following state of things occurs. The molecules at these surfaces being in a comparatively free state, although electrically joined, do of themselves so arrange their form, their number in contact, or their pressure (by increased size or orbit of revolution), that the increase and decrease of electrical resistance of the circuit is altered in a very remarkable manner, so much so as to be almost fabulous.

The problem being solved, it is only necessary to observe certain general considerations to produce an endless variety of microphones, each having a special range of resistance.

The tramp of a fly or the cry of an insect requires little range, but great sensitiveness; and two surfaces, therefore, of chosen materials under a very slight pressure, such as the mere weight of a small superposed conductor, suffice; but it would be unsuitable for a man's voice, as the vibrations would be too powerful, and would, in fact, go so far beyond the legitimate range, that interruptions of contact amounting to the well-known "make and break" would be produced.

A man's voice requires four surfaces of pine charcoal, as is described in my paper to the Royal Society, six of willow charcoal, eight of boxwood, and ten of gas carbon. The effects, however, are far superior with the four of pine, than with either the ten of gas carbon or any other material, as yet used. It should be noted that pine wood is the best resonant material we possess; and it preserves its structure and quality, when converted into the peculiar charcoal I have discovered and described.

It is not only necessary to vary the number of surfaces and materials, in accordance with the range and power of the vibrations, but these surfaces and materials must be put under more or less pressure, in accordance with the force of the sonorous vibrations. Thus for a man's voice, the surfaces must be under a far greater pressure than for the movements of insects. Still, the range of useful effect is very great, as the boxes which I have specially arranged for a man's voice are still sensitive to the tick of a watch.

In all cases it should be so arranged that a perfect undulatory current is obtained from the sonorous vibrations of a certain range. Thus, when speaking to a microphone transmitter of human speech, a galvanometer should be placed in the circuit, and, while speaking, the needle should not be deflected as the waves of + and — electricity are equal, and are too rapid to disturb the needle, which can only indicate a general weakening or strengthening of the current. If the pressure on the materials is not sufficient, we shall have a constant succession of interruptions of contact, and the galvanometer

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needle will indicate the fact. If the pressure on the materials is gradually increased, the tones will be loud but wanting in distinctness, the galvanometer indicating interruptions; as the pressure is still increased, the tone becomes clearer, and the galvanometer will be stationary when a maximum of loudness and clearness is attained. If the pressure be further increased, the sounds become weaker, though very clear; and as the pressure is still further augmented, the sounds die out (as if the speaker were talking and walking away at the same time), until a point is arrived at where there is complete silence.

When the microphone is fixed to a resonant board, the lower contact should be fixed to the board so that the sonorous vibrations act directly on it. The upper contact where the pressure is applied should be as free as possible from the influence of the vibrations, except those directly transmitted to it by the surfaces underneath; it (the upper surface) should have its inertia supplemented by that of a balance weight. This inertia I find necessary, to keep the contact unbroken by powerful vibrations. No spring can supply the required inertia; but an adjustable spring may be used to insure that the comparatively heavy lever shall duly press on the contacts.

I will ask you whether there is, with our knowledge of to-day, any practical difficulty in constructing apparatus which when spoken to with an ordinary tone of voice, will perform the operation there described, and will cause articulate speech to be heard and understood by one listening at a connected telephone receiver of the kind in commercial use to-day and at the time when that article was written?

Ans. There is not.

Int. 273. In that article Prof. Hughes mentions carbon as a desirable material for the electrode, and referring to the mechanical structure of the instrument, says: —

When the microphone is fixed to a resonant board, the lower contact should be fixed to the board so that the sonorous vibrations act directly on it. The upper contact, where the pressure is applied, should be as free as possible from the influence of the vibrations, except those directly transmitted to it by the surfaces underneath; it (the upper surface) should have its inertia supplemented by that of a balance weight. This inertia I find necessary, to keep the contact unbroken by powerful vibrations. No spring can supply the required inertia; but an adjustable spring may be used to insure that the comparatively heavy lever shall duly press on the contacts.

Will you state whether those physical features of the instrument are or are not adapted to make it perform the described operation with the described result?

Ans. They are adapted to do this.

Int. 274. Do you find physical features of that described character in the Reis transmitter?

Ans. I do not.

Int. 275. Do you find physical features of that described character in the transmitter of the defendants' apparatus?

Ans. I do.

[*Complainants put in evidence said two articles, to be marked "Hughes; May 9, '78, Microphone Article," and "Hughes, June 8, '78, Microphone Article."*]

Int. 276. You have stated that speech is transmitted electrically by causing and by utilizing electrical undulations similar in form to the air vibrations of the sound to be transmitted; do you think that any apparatus which has ever been constructed will make those undulations to be copies of the sonorous undulations with theoretical and mathematical accuracy and perfection?

Ans. I do not know of any apparatus which would do this with absolute mathematical accuracy; but either the magneto transmitter on the microphone transmitter will do this with sufficient precision to enable them to be successfully and practically employed in the art of transmitting speech.

Int. 277. When a telephone apparatus is brought to you and set in operation by the voice, can you tell whether the current changes in it are substantially the current interruptions mentioned in the Reis article, which have been referred to, or substantially the electrical undulations similar in form to the sonorous vibrations mentioned in the Bell patent, No. 174,465, and in the Hughes article, an extract from which was given in Int. 272?

Ans. I can readily tell in which one of these two ways the current changes are produced.

Int. 278. If the preceding question can be answered by experimental proof or tests, will you please state the nature of the tests adapted to answer it?

Ans. No instrument is so well adapted to determine the nature

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of such rapid current variations as are produced either by the Reis transmitter, the magneto transmitter, or the microphone, as a magneto telephone receiver of the ordinary butter-stamp pattern. I think that the nature of the tests by which one would ascertain the character of the electrical variations produced by different forms of transmitter will be more clearly understood if I analyze at some slight length the nature of the test which a magneto receiver furnishes, and the nature of the evidence which satisfies me of the substantial identity existing between the currents produced by a magneto transmitter, and those produced by a microphone transmitter, as, for example, the transmitter employed by the defendants.

In any experimental study of electrical changes, there are two ways by which we may determine the nature of those changes: —

1. We may study the instrument producing those changes, and observe its construction and its mode of operation. We can thus ascertain what will be the effects which, according to existing knowledge, must result from this operation.

2. We may make use of some instrument which is adapted to detect the occurrence and enable us to determine the nature of such changes as we have reason to believe are produced.

Considering the application to the telephone of the second mode of proof which I have mentioned, we know that telephonic currents are characterized, 1st, by great rapidity in succession; 2d, by great feebleness; 3d, by peculiarities analogous to the form of an acoustic wave. We must therefore employ some testing instrument which will detect changes of this peculiar nature. The Bell magneto receiver is universally recognized as, among all instruments, the best suited to this purpose. The galvanometer and the electro-dynamometer will not suffice, since they are not adapted to exhibit to an observer these phenomena in their completeness, as they will neither of them take cognizance of the nature of the rapid changes in the strength of the current, which are employed in transmitting sound vibrations; whereas, what we wish to study and compare in two instruments is the nature of the changes in the strength of the current and not its absolute average strength.

Using such a magneto receiver to compare the current variations

produced by an instrument like that shown in Fig. 7 of the Bell patent, No. 174,465, and such an instrument as the defendant's transmitter, we find that the sound heard by the ear at the receiver when a given sound is produced at the transmitter, is substantially the same in its quality or articulate character in both cases. It follows that the air at the ear of the listener at the receiver in the two cases must vibrate in substantially the same manner, and, to produce the same articulate speech, must have the same character of vibration due to form. But the air is in both cases set in motion by the vibrations of the plate at the receiver; hence the plate must in both cases have the same form of vibration. If the same word is spoken into either transmitter, the same word is heard at the receiver; hence the character of the vibration of the plate must be the same in both cases. The vibrations of the plate are in their turn produced by variations in the strength of the magnet, so that there must be the same form or character in variations in the strength of the magnet in both cases. Again, these magnetic variations are due to variations in the strength of the current, and as the magnetic variations are the same in character with either transmitter, the current variations producing these cannot but be the same in their character or form. Not only do these general statements hold, but the well-known mathematical laws connecting the different links in this chain of results are such that even a very slight change in one will cause a change in the others, which would necessarily be recognized. Hence, there cannot be any material difference between the character of the currents in two such instruments as I have compared.

On the other hand, if we place a magneto receiver in circuit with a circuit-breaking transmitter, like the Reis, we find that the sounds produced at the receiver are totally different in their quality from those which are produced when a microphone transmitter, such, for example, as the defendants' transmitter, is used; so that by tracing the several steps in the operation backward, we are forced to conclude that the current changes are entirely different with the Reis transmitter from what they are with the defendants' microphone transmitter.

We can also employ in this study the first method of proof which I mentioned; that is, determining those effects which, according to

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existing knowledge, should result from the operation of the transmitter. Let us consider the nature of the changes that would be produced upon known principles when a microphone like the defendants' transmitter is actuated by sound waves produced by the voice. In the first place, it is a known fact that the change of current which is brought about by such a change of pressure between the electrodes as the voice is capable of producing is recognizable not only with the telephone but also with a delicate galvanometer. This has been proved by slowly and carefully varying the pressure between two electrodes put in circuit with a sensitive galvanometer and apparatus adapted for measuring slight and slow variations in resistance. It is also a well-ascertained fact that the change thus produced in a current corresponds to the change of pressure under such circumstances as exist in a microphone like the defendants' transmitter. This fact has been abundantly proved by repeated experiments.

The defendants' transmitter is mechanically arranged, so that one using it may obtain variations in pressure between the electrodes corresponding in character with the variations in the air waves produced by the voice. Hence, in accordance with well-known laws, if we consider the results which should follow when such a transmitter is actuated by the voice, we find that variations in the current should be produced which will have the same character as those which on both mathematical and experimental grounds are known to exist with the form of telephone described by Mr. Bell and illustrated in Fig. 7 of his patent, No. 174,465.

Now when we place a suitable testing instrument, such as a magneto receiver, in circuit with the defendants' or other microphone transmitter, we observe precisely such consequences as should, according to our knowledge of the laws of nature, result from the mode of operation of the transmitter, and these consequences are the same as should, according to known laws, and actually do result from the operation of the magneto transmitter. Hence, both study based on the known laws of electricity and magnetism, and practical testing give the same results as to the nature of the current changes in the two cases. In such a comparison as this, I should, therefore, be forced to conclude that the nature of the current variations produced and utilized in the two cases are substantially identical. It is, of

course, true that of any two instruments, one may approach more closely to perfection than the other as to clearness or loudness of articulation, but that the same articulation is heard in both cases shows that the mode of operation is the same.

Int. 279. Will you give us some idea of how valuable and sensitive a testing apparatus the ordinary magneto telephone receiver is, for the purpose of disclosing absolute interruptions or other similar disturbances in an electrical current, including the case of such interruptions in a uniform current and such interruptions in an articulating undulatory current?

Ans. The magneto receiving telephone has been universally recognized as an excessively delicate instrument for testing as to the existence and nature of extremely delicate changes of current. Kohlrausch has substituted a magneto receiver for a delicate galvanometer in a form of Wheatstone's bridge, used by him, in which alternating currents are employed. Hughes has employed it in his induction balance, and Spottiswoode in investigating the nature of the electrical discharge through a vacuum tube. I have used a magneto telephone myself, and studied its value as a detecter of breaks and small current variations. I have found it capable of detecting an interruption or sudden variation in the strength of either a constant battery current or such an articulating current as is produced by a telephone, when this interruption or variation did not last more than $\frac{1}{50000}$, or in some cases, if I recollect rightly, even $\frac{1}{70000}$ of a second.

Int. 280. Will you state how the certainty arrived at in the way you described, compares with the certainty on which are based scientific researches in electricity, the construction and use of scientific and electrical apparatus, and on which are based the practical applications of electricity in the arts, and the construction of instruments of various kinds for commercial use.

Ans. The certainty thus reached is precisely that certainty which raises electrical research to the rank of a science. We are ignorant of the ultimate nature of electricity, as we are ignorant of the ultimate nature of gravitation or of matter, but the laws of its action are very perfectly known, and variations in its amount can be measured with wonderful precision. The laws of electrical currents are so well

known that they are subject to mathematical calculation, and we are able to predict with great certainty what will take place under different circumstances. All of our electric measuring apparatus is based upon those mathematical formulæ which express the laws of electrical action. Whenever either in the laboratory or in the arts we construct a particular kind of instrument, we know that with it, under definite circumstances, definite and identical changes of current will follow. The certainty which we have as to the results of our measurements is a certainty which is abundantly sufficient to maintain science and support the arts.

Int. 281. Two or three years ago, in the Ghegan case, you presented a statement of some experiments you had made which bear upon the subject of your last answers. If you have collected in a convenient form a statement of those experiments or most of them, will you present it, and read it as part of your answer.

Ans. In the experiments in the Ghegan case, the point mainly in view was to ascertain whether the variations of pressure operating in the microphone transmitter are competent to produce electrical undulations similar in form to the sound waves, and sufficient to account for the transmission of speech. To ascertain this, measurements were made of the effects of excessively slight variations of pressure between contact pieces of carbon and other materials when produced gradually.

I also made use of a carbon transmitter, with its contact surfaces so arranged that under the action of the voice the pressure between these was varied while the electrical contact could not possibly be broken. The electrodes of the transmitter were also arranged in such a way that they were pressed together by a force far too great on mechanical principles to allow of separation with the small forces applied. In some experiments the electrodes were clamped so that electrical continuity could not be interrupted. With all these forms of instrument I observed the results which I obtained with a magneto receiver interposed in the circuit. Comparing these results with what I obtained in defendants' transmitter and other microphones, I was convinced that the currents and the nature of the action causing them were essentially the same in all.

Proceeding further, I produced at the transmitter intermittences and other sudden disturbances of excessively minute duration, and under such conditions of arrangement of battery and circuits that they should produce the least possible effect. I caused these to be produced on a line over which speech was being transmitted. A peculiar characteristic disturbing sound occurred in the receiver whenever I introduced those disturbances, and long before they reached any such magnitude as the interruptions which Reis used in his battery circuit, speech was completely obliterated.

I found no such disturbing causes to arise when listening to the defendants' receiver, or any other receiver put in circuit with their transmitter, and became sure that such disturbing causes did not exist.

In studying the capacity of the magneto receiver as a testing instrument, I have found no kind of sudden disturbance, especially of the nature of a break, which did not reveal itself by a characteristic sound at the receiver interfering with, and if carried sufficiently far, destroying articulation; though long before articulation is destroyed, the disturbances are recognized as impairing articulation. I found no such disturbances with the instrument of the defendants.

The experiments to which I am referring have been collected and put into complete form, and I here produce a copy:—

Several years ago I made a long series of experiments with a view to determine whether a microphone actually breaks contact while transmitting articulation in the most approved manner. I will state the results which I reached by these experiments, and which are briefly as follows:—

When, by the sound of the voice, the two electrodes of a microphone are so moved with reference to each other as to vary the force with which one is pressed upon the other, without interrupting the electrical current, articulation by any well-constructed instrument can readily be transmitted with very great perfection; on the other hand, when the vibration becomes great, so that they part company sufficiently to interrupt the current, a perfectly marked and peculiar sound is heard in the receiver, which, if frequently repeated or long continued, absolutely interrupts articulation. If this occurs but seldom, or for an instant at a time, it disturbs articulation, but does not absolutely prevent the sounds from being recognized and the sentence from being understood. There seems, also, besides the clicks and disturbances which operators with the telephone are

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accustomed to speak of as "breaks," to be an intermediate sort of condition frequently known as "scratching" or "jarring," in which abnormal sounds, not quite so sharp as those caused by breaks, yet perfectly distinguishable from articulation, come in and disturb, and, if sufficiently violent and long continued, prevent articulation from being transmitted. These sounds are readily produced by scratching one carbon over another without separating them, or by very rapidly moving them apart, nearly but not quite to the point of interrupting the current; jarring or rubbing them together will produce these sounds; jarring the table or wall which supports the instrument will also produce them. They appear to be due to abnormal disturbances of the contact, which prevent the electrical variations from taking the form of true articulating undulations, and yet do not always disturb them sufficiently to cause the sounds to be unrecognizable. The ear seems to have the power, particularly when the attention is directed to this end, of perceiving articulate sounds in the midst of a great many disturbing noises; we always recognize this in talking in a crowded room, and the same faculty is quite noticeable when the ear is listening to a receiving telephone actuated by currents over a circuit on which the true articulating undulations have been produced, but are more or less deformed or disturbed by extraneous electrical causes, either in the nature of interruptions or of superposition of different sorts of currents or variations. This is always noticed in the telephone, in ordinary use, when there is a "cross" on the line, as it is called; that is, when currents come in from another line from an accidental misconnection, or when there are those disturbances from leakage or induction which are very prevalent on city lines. It not unfrequently happens from accident, such as the crossing of two wires, that the listener at the telephone hears two people talking at once. The currents which then reach the receiving telephone and the sounds which reach the listener's ear are not simply the electrical undulations due to the voice of the person he desires to listen to, but are considerably deformed by the speech of the other; and oftentimes by fixing the attention you can hear and understand the one person or the other, or sometimes both. It is certain, therefore, and is a matter of every-day experience, that for the recognition of an articulate sentence it is unnecessary that the sound heard by the listener should be *exactly* the same as that uttered by the speaker; it may be mingled with other noises which may be so slight as not to be important, or so serious as to be annoying; and which finally may become so great as to be destructive, either by practically changing the character of the sound or by deadening the ear to the more delicate changes which constitute articulation.

I am entirely certain that the defendants' transmitter and other microphones transmit speech by varying the current in substantial

accordance with the actuating sound waves, and not by interrupting it; that every interruption of the current which any known instrument can produce, causes, in the telephonic receivers in ordinary use, a distinct and characteristic sound which is quite different from articulation, and which does not aid articulation, but disturbs it. When sufficiently increased, this disturbance becomes so great that the listener ceases to understand speech. The slightest interruptions of the battery current, occurring with a frequency much less than that of the vibrations characterizing articulate speech, become not only noticeable as disturbances, but destructive of speech.

These interruptions produce two disturbing effects; considered merely as interruptions of the electrical path between the transmitter and receiver, they for the time being cut off connection between them; however short this may be, some characteristics are lost When this interruption is for a small fraction of a second and is not too often repeated, familiar sounds, including words, are still recognizable by what is left, and in spite of (but not by reason of) the loss. But if the interruption occurs in a circuit in which a battery is placed (and a battery is always and necessarily placed in the circuit which includes the working contact of the defendants' transmitter), then instead of the slight variations of current due to the merely varying (but not interrupting) operation of the microphone, amounting to only a small percentage of the full force of the battery current, the whole force of the current will, by the breaks, be thrown off and on, and abnormally great variations will take place; of themselves they will produce in the receiver a sound abnormally loud and distinctly recognizable as characteristic of a break, and entirely different from articulation. When the slighest effect of this kind is added to the microphonic effects, its disturbing character is at once perceived, and as it is increased the disturbance becomes so great as to drown the articulation.

By many experiments, some of which I will state, I have satisfied myself that it is practically impossible, by any known instrument, to produce an interruption of a battery current which the speaking telephone receiver will not recognize as a disturbance; that any such interruption, however slight, if at all frequent, destroys the utility for commercial use.

I constructed an apparatus in which I could produce, at the same time and by the same action of the voice on the same diaphragm, articulating undulations in one part of the apparatus, and makes and breaks in another, and then at pleasure connect the two in one circuit, so that the results of both should pass over the same circuit to the same receiver.

For this purpose I took a Blake transmitter with the electrodes arranged in the usual manner, one of them being of carbon and the other of platinum, as usual. Close alongside of these electrodes and connected to the same diaphragm, so as to be subject to precisely the

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same motions, I arranged another pair of electrodes, both of platinum, as follows: one of this auxiliary pair consisted of a platinum electrode precisely like that of the ordinary Blake, but in this instance soldered to the diaphragm. The other of this auxiliary pair of electrodes consisted of a platinum contact piece rigidly fastened to a stiff cast-iron lever, which could be adjusted towards and away from the first platinum electrode of the pair by means of an adjusting screw, so that I could give to the two platinum electrodes such adjustment as I desired, and could place them either in very delicate contact with the slightest touch which would permit a current to pass, or just out of contact at the smallest distance which would interrupt the current. I adjusted the carbon contact so as to give good articulation when the mouth of the speaker was brought quite close to the instrument and exerted with rather more force than usual. With this arrangement perfectly good articulation was transmitted with ease. I then arranged the platinum electrodes in excessively delicate contact with each other, by which I mean that I brought them up together with the slightest touch which would permit the current to pass, and with as little pressure as possible. My idea was that I could thus speak to the diaphragm in a loud voice, and cause the carbon contact to produce the articulating undulations without break of contact; while the platinum contact pieces which had been brought farther apart, though still in electrical contact, and with the back one rigidly held and unable to follow the motion of the diaphragm, would generally part company and interrupt the current with the slight motions of the diaphragm, which would be insufficient to break the main contact when its platinum and carbon electrodes were firmly pressed together. Testing them separately, I found that this could be done by carefully modulating the voice, using a very loud tone. Intelligible speech in this tone could be transmitted with the carbon contact, but not with the platinum contact.

I then connected them together in one circuit, talking to the diaphragm now in the same loud tone that I used when talking to each separately. It was manifest that the carbon or articulating contact would operate as before; that is, would produce articulating undulations, and that the platinum contact would act as it did before, to produce breaks of an extremely delicate and slight character. When talking in an ordinary voice several inches away from the instrument, I got articulation and intelligible sentences due to the action of the carbon contact, and I recognized that the sound was substantially the same as when the platinum was not connected with the circuit, the motions in this case being too slight to break the continuity of the platinum contact. As I increased the effect of the voice, by causing the speaker to approach closer to the instrument and speak louder, the vibrations were still too weak to break the carbon contact, as I found by experiment, but were strong enough to break the peculiarly arranged platinum contact. This

fact was instantly noticed in the receiver by the abnormal and sharply disturbing noises which were now added to the articulation. They were totally distinct from articulate sounds, and were markedly noticeable as disturbances, hindering, and finally drowning out speech for all purposes of practical utility, though some words were still recognized.

When the voice was at its loudest, producing the most disturbing effect, I caused the speaker to gradually speak more gently. As his voice fell off in violence, the disturbing noises became less, then ceased entirely, and the pure articulation came as before. The vibrations of a tuning-fork and the sounds of singing, and the prolonged note of vowel sounds, were also tried with similar results. The experiment was repeated many times.

This experiment has a special value. In it the vibrations of the diaphragm produce (by the finely adjusted carbon contact) those electric variations which transmit speech in the ordinary microphonic action of a microphone suitably adjusted for practical use; upon this are superposed interruptions of the battery current produced by the strong vibrations of the same diaphragm acted upon by the same sound. Thus the breaks at the platinum contact coincide in time with the minimum of current due to the action of the speaking or carbon contact, and are of the same frequency as the vibrations of the electrodes, with perhaps some omissions. These breaks produce in the receiving telephone sounds of peculiar character, which the ear readily and distictly recognizes as disturbing and inarticulate noises; while, when by gentleness in the voice or by suitable changes in the adjustment of the platinum contact they are excluded, the modulations, due to the non-breaking carbon contact, are manifest by the articulations which they produce.

These experiments, if I had made no others, would have satisfied me that the telephone receiver is the most delicate detecter known of any abnormal disturbance in the currents, — particularly breaks or anything in the character of breaks, — by the peculiar and special sounds due to the slightest electrical disturbance of this nature. This is a fact generally recognized by scientific men.

I caused to be constructed a microphone with the parts so arranged as to permit of easy observation of the contact pieces. I made both of them of hard carbons, rounded and smoothed, and mounted one electrode so as to be in loose contact with the other when at rest. With this, speech was transmitted with entire ease, using a natural tone of voice and speaking several inches away. I then caused the voice to come nearer, to increase in loudness, and caused to be made various prolonged sounds which were adapted to give unusually great vibration to the instrument. During this time I observed the carbons with a microscope, which, in the various experiments, magnified from thirty to fifty diameters. Placing in the microscope a finely ruled glass eye-piece micrometer, I selected some

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little spot or protuberance on the carbon near one of the lines, and watched it. When thrown into rapid vibration, the spot, by a well-known effect, appeared to widen out into a blur, the width of which denoted the range of the vibrations. Having carefully watched the width of this blur under the influence of the vibrations produced by the voice, I ascertained that the vibrations due to ordinary speech, which was quite loud and perfectly understood, were so slight that they could with difficulty be detected by the microscope. As the voice was so exerted as to produce more powerful vibrations, the blur widened out more and more. I then, by means of a fine screw, drew back one of the electrodes until it had passed from a good working adjustment to a point where a galvanometer in the circuit showed the current to be interrupted, stopping with the smallest motion which produced this effect. During this time I watched the motion of a spot on the carbon with the microscope, and by the lines observed the distance necessary to break the circuit. Comparing this with the greatest range of vibrational movement produced during the transmission of speech with good articulation, I found that the smallest motion which would interrupt the current was many times greater than the largest due to the articulating vibrations.

During these experiments, also, I or another observer listened at a receiving telephone of the ordinary hard rubber pattern, included in the circuit. Any break observable by the galvanometer gave the usual characteristic sound in the receiver, so that we were thus satisfied that it became a reliable test of that break. The larger ranges of vibration which more nearly approached the breaking distance, but did not reach it, gave the abnormal sounds, generally known as "scratching," which precede a full break and which partially or wholly prevent the reception of speech. When by appropriate means the instrument was thrown into violent vibrations (an electromagnet being included in the circuit), sparks were frequently observed with the microscope. They were always accompanied by the well-known disturbing sound of a break. I repeated these experiments many times on different days until I satisfied myself that the results could be relied on.

I also tried the same kind of microscopic experiments with such a microphone transmitter as was used by the defendant in the Ghegan case, known as the Hopkins transmitter. Directing the microscope upon the contact of the two carbons, the corruscations of sparks which took place under the effect of abnormally loud vibrations were very striking. In such case and with any variations that produced sparks, the characteristic sounds already referred to were heard, and if the sparks were at all numerous, articulation became lost. In speaking to the instrument in a natural tone, and when in its best adjustment for speech, conversation was carried on as usual, and no sparks whatever appeared. Under these circumstances, the range of vibration of the Hopkins microphone was rather less than

in my experimental instrument, and was many times inside the breaking limit.

Mere observation of the contact points, with or without the microscope, does not always enable one to say surely whether they are in contact or not. There is a well-known optical difficulty due to irradiation. Having satisfied myself on this point, I employed electrical tests, such as the galvanometer, to determine the electrical contacts.

These tests with the microscope satisfied me that no motion sufficient to interrupt the current takes place in any microphone when transmitting speech with the perfection required for commercial use. They also satisfied me that no break occurred in the circuit without the peculiar characteristic sound which the ear recognizes as a disturbance, and which, as it becomes more frequent and extensive, destroys articulation.

This confirmed the conclusions from other forms of tests, that speech is, in all cases, transmitted, not by breaks, but, when they occur, in spite of them.

I am sure that it is absolutely impossible to break the circuit with an articulating microphone, or to closely approach breaking the circuit without the production of an abnormal or disturbing sound, which the ear perfectly recognizes as distinct from articulation, and which is very injurious to articulation; and that when this is sufficiently frequent or sufficiently violent it prevents the transmission of speech.

It is true of all microphones capable of delicate adjustment that conversation carried on several feet away from it may be transmitted, while the ordinary distance in practical use is from three inches to a foot. It is impossible for any one to believe that articulate sounds of ordinary conversation made ten feet from such an instrument can throw its iron diaphragm into such violent vibration as to break contact of the electrodes. I find that talking as far from the instrument as would have any effect upon it in transmitting articulate sound, and then moving up towards the instrument and gradually increasing the volume of voice, increases the loudness of the tones heard in the receiver but does not change their character. When the mouth of the speaker is brought very close to the instrument, say within an inch or so, and the voice is exerted to the utmost, of course a much more violent vibration is given to the diaphragm, and it is obvious that in that condition breaks will be more likely to occur than in any other. Now, while approaching the voice from a distance of several feet to a distance of six inches, even also raising it somewhat, the character of the sound received at the receiver does not change; but the more violent exertion of the voice, when brought within one inch of the receiver, does produce a change. The change which this produces consists in the production of sounds substantially similar to those which I have caused by various devices for breaking the circuit; and the sounds thus produced by this

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violent and close application of the voice are not only disagreeably perceived by the ear, but are perceived as quite different from anything which occurs in the articulation up to that point, and distinctly as disturbing and inarticulate noises; as they increase in frequency and extent they drown out conversation. I am convinced from this use of the instrument, that breaks do not occur in the first and distant application of the voice; that they can be made to occur by the violent application of the voice when the mouth is brought extremely close to the instrument; that as the force applied by the voice is increased from the one extreme to the other, there comes a point where, with the more violent exertion, sounds which are distinctly recognized as breaks, or in the nature of breaks, are first heard; and they are heard as disturbances, destructive of articulation to a greater or less degree. With a microphone transmitter properly adjusted for commercial use, I have not found it possible to produce these disturbing breaks with the voice at a distance of much more than ten or twelve inches from the diaphragm; nor are they produced except accidentally by any application of the voice, such as takes place in a telephone when used in the manner commonly employed for business purposes, and the instrument in ordinary adjustment; and I am sure that any man who expected to be understood by the listener at the other end in the most convenient manner, would not use his voice in the extraordinarily violent manner I have mentioned. I am satisfied from this that whatever it is possible to produce with the instrument in a laboratory experiment by an operator seeking to ascertain whether he can make it break, breaks will not occur in its ordinary use by a person engaged in transmitting speech by it for commercial purposes, except by accident. Inasmuch as the operation of the instrument, when the voice is applied to it gently and from a considerable distance, is clearly not that of breaking the circuit, it is impossible for me to believe that gradually approaching the voice to it causes any marked change in the nature of its operation, until such time as that change in the nature of the operation is shown in the result; and when any such change appears in the character of the result, it is invariably a change impairing and finally destructive of articulation.

I have also experimented with the following instrument, which clearly excludes the possibility of breaks: —

April 20, 1879, F. K. Fitch patented a form of battery transmitter, which consisted, in the instrument I used, simply of two disks of hard carbon about one and seven eighths inches in diameter, and one eighth to one quarter of an inch thick. The lower one rested horizontally on a bed of wood or vulcanite, and the upper one, which in this case was three sixteenths of an inch thick, was simply laid on top of it. No diaphragm is employed, but the sound waves fall directly on the upper carbon. It appears mechanically impossible that in such an instrument, when so used, the carbons can part

contact under the ordinary tones of the voice. Yet, under such circumstances, it transmits intelligible and good speech. This can only be because the variations in the force with which the sound waves press the carbons together vary the electrical conductivity of the contact in substantial accordance with the sound waves.

Subsequently, Professor Wright made some other instruments of the same type, which he has described in his affidavit. They consisted of pieces of hard gas carbon with polished surfaces, varying from two grammes to three quarters of a pound in weight. The contact surfaces of the smallest consisted of a circle five eighths of an inch in diameter, and the largest of a square of three inches. One carbon was laid on top of one or more of the others in the various forms indicated by Prof. Wright's drawing, and speech was directed against the upper one. Under these circumstances, all of these transmitted excellent speech of a pure and clear tone, perfectly good for commercial use. A tuning-fork and resonator were also used as the source of sound. In some cases the stem of the vibrating tuning-fork was also pressed forcibly down upon the upper carbon, and the sonorous vibrations thus mechanically excited gave the pure tone of the fork in the connected telephone receiver. The experiments were varied by placing brass weights of from twenty to seventy grammes on top of the upper carbon, particularly in the case of the large, thin, square carbon. Also, one or two fingers were laid gently on top of the upper carbon, pressing it down upon the other. This slightly diminished the volume of tone, but still left it quite loud enough for practical business purposes, and made the articulation rather more perfect as regards clearness and sharpness of definition, and fidelity and agreeable quality of tone. When a violently vibrating fork was placed on some of the lighter carbons, a scratching noise was perceived; but under all ordinary circumstances we obtained the same pure and clear tone found in all good telephones, and in the defendants' transmitter when in its best adjustment.

The battery used varied from one cell Leclanché, or one cell of Grove, up to four cells of Leclanché, the stronger battery being used with the larger carbons. An induction coil was also used.

Connecting several pairs of these carbons at different times in circuit with one or two cells of battery, and a tangent galvanometer of very low resistance (less than one ohm), moderate pressures exerted by placing the finger on the upper carbon would cause the needle to deflect more strongly, showing that increase of pressure increased the current, and *vice versa*.

These experiments (in addition to many others) show that variations in the force with which one carbon electrode is pressed against the other vary the electrical conductivity of the contact; they also show that such variations in this force as the voice exerts in ordinary speech produce sufficient changes in that electrical conductivity

to transmit that speech. This kind of operation is the necessary result of this application of force; it will account for the results produced; no other operation which I can conceive as possible under these circumstances will account for the results.

According to the method described in the fifth claim of Mr. Bell's patent, No. 174,465, electrical undulations similar in form to the sound waves are caused by the sound waves themselves, and then are utilized to produce at the receiving station the same articulate sound. I am sure that it is impossible for any instrument to be so ideally perfect as to reproduce the sound with absolute and mathematical fidelity; and therefore I consider that the method is substantially employed whenever articulate sounds which are recognizably the same as those spoken into the transmitter are produced at the receiver by the employment of current variations (caused by the voice), which are recognizably similar to the sound waves, and which, though to some extent misshapen, deformed, injured, disturbed, weakened or lost, yet produce the same result by reason of so much of the true form as is created and preserved; because in such case the speech is transmitted by reason of the articulating undulations, and in spite of the imperfections thereof.

JUNE 23, 1885.

Int. 282. Since you testified in the Ghegan case you have, I believe, made some experiments of a similar nature with another microphone provided with a clamp, which you could use or not at pleasure. Will you please state the nature of those experiments, and what they were?

Ans. I have compared the effects produced by a microphone working in the usual manner, so as to produce variations of current by variations of pressure, with those produced by the same or similar electrodes, when so adjusted or operated as to produce breaks in the current, using a form of transmitter which is furnished with two sets of the ordinary Blake contact pieces of platinum and carbon placed symetrically on the same face of the diaphragm, one set on each side of the centre and as near to the centre as possible. The two sets of contacts are entirely independent of each other, and each is furnished with the device commonly used with the Blake transmitter for producing the desired normal pressure. Each pair of electrodes is also so arranged that they can be clamped and absolutely prevented from parting contact. The platinum electrodes are attached to the diaphragm, and the carbon electrodes are suspended

by springs, as is customary with the Blake transmitter. The two sets of electrodes could be used in the same or in separate circuits.

I have tried the following experiments : —

(1.) Placing one pair of the electrodes, which I will call No. 1, in circuit with a battery and receiving telephone, I adjusted the electrodes as is customary for the transmission of speech. On speaking to these in an ordinary tone of voice, good articulation was heard, free from breaks or disturbing noises in the nature of breaks.

But on speaking louder and louder to the transmitter, disturbances were heard which became stronger and more frequent as the voice was raised, and finally rendered speech unintelligible. These disturbances were of the same character as those which I have observed with circuit-breaking instruments like the Reis transmitter, or with a break-wheel.

When the voice was raised considerably so that great disturbances caused by breaks, were heard in the receiving telephone, sparks could be seen by watching the transmitter in a darkened room, and whenever these sparks were seen frequently, the disturbance became excessively great, although very marked interference with speech occurred even before this limit was reached.

(2.) I then carefully clamped the electrodes (No. 1) so that it was impossible to break the current by the application of a force to the diaphragm. I proved that the current could not be broken thus by tapping the diaphragm violently, pushing it with my finger, and in other ways. Then I spoke to the transmitter more and more loudly. Speech was distinctly reproduced in the receiver, but no sounds of breaks or sounds approaching those due to breaks were heard, nor could any sparks be observed at the transmitter.

(3.) I then unclamped the electrodes (No. 1) and adjusted both pairs (No. 1 and No. 2), so that they were alike as to normal pressure, and both unclamped and in the ordinary adjustment for transmitting speech. Placing each in circuit with a battery and receiving telephone, I found that speech was transmitted clearly and distinctly by both, so that there was no difference that I could detect between them.

(4). Raising the voice was then found to give the same results in both receiving telephones, speech gradually becoming more and

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more interfered with as the disturbances increased, until it was entirely obliterated in both. Sparks were also seen at both pairs of contacts.

I thus established the fact that these two sets of contacts were exactly alike in their mechanical arrangements, and in the effects which they produced, and, especially, that both transmitted speech in the same way under the ordinary operation of the voice, and that when the voice was applied with such abnormal force as would mechanically tend to produce breaks, the results of these breaks were equally evident, and produced the same effect in both.

I then proceeded to alter the conditions of one of them by clamping it in such a way that breaks became absolutely impossible, reasoning that on repeating the experiment, I should now find, if my views were correct and the disturbances due to breaks, that they would continue to exist in the circuit containing the electrodes which were able to break, and be obliterated in the circuit in which were the electrodes that were not able to break. This I did as follows :—

(5.) I clamped one pair of the electrodes so as to absolutely prevent breaking of the current, leaving the other adjusted as before. On speaking to the transmitter in an ordinary tone of voice, speech was transmitted by both, and without disturbing sounds. On raising the voice, I found that with the receiver which was placed in the circuit with the clamped electrodes, speech was transmitted as well as ever, and without disturbing noises, while with the receiver placed in circuit with the unclamped pair of electrodes, the disturbing noises due to breaks occurred when the voice was raised, and increased as it was still further raised, until finally, speech ceased to be intelligible. Also, sparks were visible between the surfaces of the unclamped electrodes, but not at the surfaces of the clamped ones.

It is clear from this experiment, that while one pair of electrodes is producing true undulations, the other is either breaking the current or introducing those violent disturbances which occur as the breaking point is approached.

(6). I then caused the currents from both pairs of electrodes to be superposed in the same receiver, and found that with an ordinary

tone of voice, speech was perfectly transmitted, but as the voice was raised, violent disturbances of the nature of breaks occurred, which interfered with articulation more and more seriously until they destroyed it altogether.

The disturbing sounds observed in the last described experiment were of the same character as those which I have noticed from the operation of a break-wheel producing very short breaks and placed in the circuit of a microphone transmitter when speech is being transmitted.

The instrument used in the investigations which I have described, was constructed with great care, so that it was fully reliable as a testing apparatus.

Int. 283. In considering the question whether the defendants' apparatus employs as the means for transmitting speech electrical undulations similar in form to the sound waves which act upon the transmitter, of what importance is it to know whether *any* breaks occur in the operation of the transmitter?

Ans. The essential element which must be present in any speaking telephone apparatus is the ability to transmit and reproduce the substantial form of the vibrations characterizing articulate speech, as distinguished from a mere reproduction of the frequency of those vibrations. This constitutes the essential difference between the method and apparatus invented by Mr. Bell, and all others which preceded it. So far as the practical result to be attained is concerned, the manner in which this characteristic of form is impressed upon the electrical undulations is immaterial.

It is of no importance whether the characteristic similiarity in form between the air waves and electrical waves is produced by the variations in electro-motive force due to a magneto transmitter; to the variations in resistance caused by a microphone or other battery transmitter; or if such a thing were possible, by a series of excessively minute breaks produced by a circuit-breaking transmitter. If by any form of transmitting telephone those characteristic variations in form to which the quality of a sound is due are impressed upon an electrical current so that the electrical undulations are similar in form to the sound waves which act upon the transmitter, the method em-

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ployed is that invented by Mr. Bell, as distinct from the method used by Reis.

Int. 284. What do your experiments show as to whether electrical undulations similar in form to the sonorous vibrations due to a spoken word, can in point of fact be produced by a series of breaks between contact electrodes actuated by a diaphragm acted on by the voice; and as to whether any breaks which such an apparatus can produce are in fact helpful or hurtful in the transmission of speech?

Ans. My experiments have convinced me of the impossibility of producing such electrical undulations by any apparatus which operates simply by producing a series of breaks between contact electrodes arranged and operated as suggested in the question; and also that any breaks produced between such contact electrodes are never helpful and always harmful in the transmission of speech.

Cross Examination resumed by A. Q. KEASBEY, Esq., *of Counsel for Defendants.*

Cross-Int. 285. Was the statement in your lecture about the transmission of speech by electricity, to which you have referred, published at the time?

Ans. I have not been able to find any copy of the report which I think was published. I feel very confident, however, that in no report which I ever saw or knew of, was this remark quoted or referred to. I think if it had been, I could not have forgotten it.

Cross-Int. 286. You spoke of statements from Prof. Bell, in the autumn or winter of 1874–75, as to a plan for the transmission of speech; did he show you then any instrument for the purpose?

Ans. He did not.

Cross-Int. 287. Have you stated in any of your former examinations the conversations on this subject which you have now mentioned?

Ans. I testified regarding this matter in the Drawbaugh case.

Cross-Int. 288. In reply to the question, how far in the Blake transmitter with one Lechanché cell the electrodes must part before the current will be actually interrupted, you seemed in doubt, but mentioned from $\frac{1}{1,000,000}$ to $\frac{1}{5,000,000}$, and said that you would not

venture to say without referring to the data given by Sir William Thomson. Have you made such reference?

Ans. After my deposition for that day was closed, I looked over Thomson's figures. They did not give me exactly what I wanted, and not understanding that I was desired to do so, I did not attempt to calculate from them what results would be given under the circumstances mentioned. It would appear from them, however, that the figure $\frac{1}{1.000.000}$ suggested in your Cross-Int 212, and which I adopted provisionally in my answer as expressing what I thought might be the order of the quantity in question, is much too small; $\frac{1}{100.000}$ rather than $\frac{1}{1.000.000}$ of an inch would probably express the order of the numerical value of the air space across which a single Leclanché cell could transmit an electrical discharge. The other figures based upon this assumption in my answer, I should have correspondingly modified had I consulted these data previous to answering the question.

Cross-Int. 289. Can you tell how far this space might be with two Leclanché cells?

Ans. Not with any certainty. It would be larger than with one, and probably not very far from double; perhaps a little more than double.

Cross-Int. 290. Then the electrodes may be parted this small distance without destroying articulation, may they not, the current not being broken actually?

Ans. Not at all; for even if the current were not actually broken, it would still be so altered that a disturbance of the same character as that produced by an actual break would result.

Cross-Int. 291. The current must be disturbed by the movement of the electrodes caused by the action of the voice on the diaphragm, in order that it may be so varied as to transmit speech, must it not?

Ans. Understanding the word "disturbed" simply to mean "varied," this is, of course, true.

Cross-Int. 292. Then the effectiveness of the transmission will depend on whether such disturbance is merely sufficient for the purpose, or is made excessive by too violent action; is it not so?

Ans. The effectiveness of the transmission will depend upon the character of the variation impressed upon the current. If the vari-

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ation or "disturbance," as you call it, of the current is such as to impress upon it those characteristics of form upon which speech depends, the transmission will be effective, and within any limits as to loudness which have yet been reached, so long as such variation or "disturbances" and such only are produced, I do not see how they can be "excessive." If the variations or disturbances are of a different nature, they will tend to interfere with the effectiveness of the transmission, and will interfere with it in proportion as they alter the character of the current from its similarity in form to the sound waves.

Cross-Int. 293. You stated when asked to point out the things which tend to make the Reis transmitter interrupt the current and the defendants' to keep it up, the mass and normal pressure of the electrodes, and the nature of the materials. If the Reis anvil piece were heavier, and the contacts were of platinum and carbon, would they then be adapted to produce undulations, as you term them?

Ans. Such an instrument as you indicate in your question would be adapted to produce electrical undulations. I should hardly think, however, of applying Reis's name to an apparatus of this kind.

Cross-Int. 294. In the Reis-Legat transmitter, described in the Reis-Legat article, page 550, Dolbear case, do not the spring *n* and the adjusting screw *h* tend to prevent the too great separation of the electrodes when the instrument is in operation?

Ans. The spring *n* might, of course, if properly constructed and adjusted for this end, oppose an effective resistance to the separation of the electrodes at *d*, and the adjusting screw *h* could perhaps be so set as to prevent breaking. That this was not done in the operation of the instrument is however evident from the facts that the spring *n* is merely referred to on page 551 as serving to keep the the contact closed when the apparatus is in a state of rest; while on page 552 it is stated that the circuit at *d g* is opened at each condensation of the air in the tube, and closed at each rarefaction. It is a mistake to suppose that a spring is well adapted to prevent the breaking of the circuit in a telephone transmitter. It serves admirably to secure the requisite normal pressure in a microphone, or to bring back into contact the electrodes of a circuit-breaker after these have been separated, but it does not have the requisite inertia for

properly preventing separation. This fact was recognized by Prof. Hughes in one of his earliest articles on the microphone. In his lecture on the Physical Action of the Microphone, he says, as I have already quoted: —

"This inertia I find necessary to keep the contact unbroken by powerful vibrations. No spring can supply the required inertia; but an adjustable spring may be used to insure that the comparatively heavy lever shall duly press on the contacts."

Cross-Int. 295. What time do you refer to in your answer to Int. 249, in speaking of the extent of your knowledge of Reis and your serious consideration of his transmitter?

Ans. I referred to the winter and spring of 1872.

Cross-Int. 296. Had you then seen the Van der Weyde articles, or heard of his public exhibitions of the Reis instrument?

Ans. I never heard of any of Dr. Van der Weyde's telephonic experiments until the summer of 1879.

Cross-Int. 297. I find in the office of Mr. Roberts, the nineteenth French edition of Ganot's *Traité de physique*, published in 1884; is that a book of any authority?

Ans. It is a book which is quite widely used as a text book in physics. It is not a book whose statements would be regarded as at all precise or authoritative on many of the matters discussed in it.

Cross-Int. 298. Do you use it as a text book?

Ans. I refer my elementary students to the English edition of Ganot for certain topics, but supplement it by some two hundred pages of printed notes, and very numerous notes upon the board, which I have found to be necessary to remedy its deficiencies and errors.

Cross-Int. 299. I find on page 1075, at the end of his article on the telephone, the following sentence: —

"En résumé, les actions et réactions dont ce téléphone est le siège, ne sont pas aussi simples qu' on l' avait cru tout d' abord, et l' on peut dire que *la théorie de cet instrument est encore à faire.*"

Will you please translate the above extract, and say whether the statement accords with your own views?

[*Question objected to because without the context, the passage quoted*

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gives an entirely incorrect idea of the subject matter, scope and meaning of Ganot's remark.]

Ans. I translate the passage as follows: —

"To recapitulate, the operations and results which take place in this telephone are not as simple as they were once thought to be, and it may be said that the theory of this instrument is still to be constructed."

If by this statement is meant that there are a great many points with regard to the electrical actions taking place in the telephone which remain to be elucidated, I certainly agree with it. If it means that we do not know the truth of the facts which I have stated with regard to the operation of the magneto and microphone transmitter, I do not agree with it.

Direct Examination resumed by Mr. Storrow.

Int. 300. Will you please read and have taken down as part of your answer, the whole extract of which a portion was given in the last question asked you, and also give a translation of it.

Ans. [GANOT, EDITION OF 1884, p. 1,072.]

"2. *Fonctionnement et théorie.* — Lorsqu' on parle à haute voix dans l'embouchure, les ondulations de l'air se transmettant à la plaque de fer doux, celle-ci vibre à l'unisson de la voix, et, suivant l'amplitude de ses vibrations, s'approche plus on moins du noyau de la bobine, en s'aimantant et se désaimantant par influence à chaque vibration. Ces variations de magnétisme produisent dans le fil de la bobine des courants induits qui se propagent du transmetteur au récepteur dans le circuit fermé *m*, P, *n*. Ces courants, d'autant plus intenses que l'amplitude et la vitesse des vibrations sont plus grandes, passent dans la bobine du récepteur en y reproduisant les variations de magnétisme qui leur ont donné naissance, et ces variations de magnétisme elles-mêmes provoquent dans la plaque de fer doux du récepteur des oscillations semblables à celles du transmetteur: la deuxième plaque se met donc à vibrer à l'*unisson* de la première; ses vibrations se transmettant à l'air, si l'on applique l'oreille contre l'embouchure, on perçoit les sons émis à l'embouchure du transmetteur.

Ces sons seront d'ailleurs plus ou moins affaiblis, par suite d'une perte de force vive plus ou moins grande dans la transmission et la transformation du mouvement moléculaire.

Remarque. — Cette théorie du téléphone à plaque de fer doux n'est pas complète. Les vibrations de la plaque vibrante ne parais-

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sent pas dues uniquement aux variations de magnétisme de l'aimant. La mesure de l'intensité des courants induits dans le téléphone Bell a prouvé qu'ils sont beaucoup trop faibles pour produire les vibrations de la plaque simplement par attractions et répulsions magnétiques. De plus, si l'on substitue à la plaque de fer doux des plaques non magnétiques, de verre, de cuivre, de bois, etc., les sons sont encore transmis, quoique avec une intensité beaucoup moindre. Sans rejeter les courants induits développés dans le fil des bobines par l'induction de la plaque de fer doux du transmetteur, on est donc conduit à admettre en outre que l'étui du téléphone et le barreau aimanté entrent eux-mêmes en vibration sous l'influence de la voix, et que ce sont leurs vibrations moléculaires qui se transmettent par les fils de cuivre jusqu' à la caisse du récepteur.

En résumé, les actions et réactions dont ce téléphone est le siège ne sont pas aussi simples qu'on l'avait cru tout d'abord, et l'on peut dire que *la théorie de cet instrument est encore à faire.*

This I translate as follows : —

Operation and theory. — When one speaks in a loud voice into the mouthpiece, the undulations of the air impressing themselves upon the plate of soft iron, this plate vibrates in unison with the voice, and, according to the amplitude of its vibrations, it approaches more or less closely to the core of the coil, becoming magnetized and demagnetized by induction at each vibration. These variations of magnetism produce induced currents in the wire of the coil which are propagated from the transmitter to the receiver in the closed circuit *m*, P, *n*. These currents being stronger in proportion as the amplitude and velocity of the vibrations are greater, pass into the coil of the receiver and reproduce there those variations of magnetism which originated them, and these variations of magnetism themselves produce in the plate of soft iron of the receiver, vibrations similar to those of the transmitter. The second plate consequently is set into vibration in unison with the first ; its vibrations impress themselves upon the air, and if one places his ear against the mouthpiece he recognizes the sounds produced at the mouthpiece of the transmitter. These sounds will be more or less enfeebled because of a greater or less loss of energy in the transmission and transformation of the molecular movement.

Remark. — This theory of the telephone, with a plate of soft iron is not complete. The vibrations of the vibrating plate do not appear to be due solely to the variations of magnetism in the magnet. Measurements of the intensity of the induced currents in the telephone show that they are much too feeble to produce vibrations of the plate simply by magnetic attraction and repulsion. Moreover, if we substitute for the plate of soft iron non-magnetic plates such as glass, copper, wood, etc., the sounds are still transmitted,

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although with a much less intensity. Without denying the induced currents developed in the wire of the coils by the induction of the soft iron plate of the transmitter, we are led to admit in addition that the case of the telephone, and the magnetized bar themselves, enter into vibration under the influence of the voice, and that it is their molecular vibrations which are transmitted by the copper wires to the case of the receiver.

To recapitulate, the transformations which occur in this telephone are not as simple as was at first thought, and it may be said that *the theory of this instrument is still to be constructed.*

Int. 301. Will you please state whether the uncertainty expressed by Ganot in the passage quoted in Cross-Int. 299 relates to the question whether in the operation of a magneto speaking telephone as a whole, the transmission of speech is due to the transmission and utilization of electrical undulations similar in form to the air vibrations due to the sound to be transmitted; or whether his uncertainty relates to the question whether parts of the instrument in addition to the plate may or may not aid, and, if so, to what extent, in the production of those electrical undulations at one end of the apparatus and their conversion into corresponding sonorous vibrations at the other.

Ans. I understand him to state that the uncertainty relates to the respective functions of the plate and other parts of the instrument in production of electrical undulations and the reproduction of sound by means of them.

Int. 302. Does Ganot express any doubt as to the operation of the microphone?

Ans. He does not. I quote the following description: —

[Page 1074.] "1006. *Microphone de Hughes.* —Le microphone est fondé sur ce principe, que si dans un circuit parcouru par un courant on place un téléphone, et en même temps un cylindre de charbon pouvant être ébranlé sur ses contacts, les plus légères vibrations imprimées au charbon modifient assez la *résistance* des points de contact, et par suite l' intensité du courant, pour produire des effets téléphoniques."

This may be translated as follows: —

"1006. *Microphone of Hughes.* — The microphone is based on this principle: that if, in a circuit through which a current is passing, we place a telephone, and at the same time a cylinder of carbon which can be jarred on its contacts, the lightest vibrations impressed

upon the carbon modify enough the resistance of the points of contact, and consequently the intensity of the current, to produce telephonic effects." . . .

Int. 303. Is Fleeming Jenkin's work on *Electricity and Magnetism*, edition of 1880, a book of recognized authority?

Ans. It is.

Int. 304. Will you please read from that book passages which you find in it which refer to the subject about which Ganot has expressed his doubt?

Ans. "In 1837, Page discovered that the magnetisation and demagnetisation of iron was accompanied by sound. P. Reiss, of Friedrichsdorf, in 1861, invented an arrangement by which a musical note at one end of a telegraphic wire was reproduced at the other end. This he effected by causing the vibration of a reed to make and break a circuit at the sending end; the current was therefore transmitted once for every period of the reed's vibration; this current magnetized a small iron core, and at each transmission a click was produced, not in itself musical, but producing the effect of a definite note on the ear when repeated a definite number of times per second. When the reed vibrated so as to give a certain note, the same note was heard at the other end of the line. The quality of the sound received had no resemblance to the quality of the sound produced by the sending reed."

"The explanation of the action of the instrument given above agrees with that given by its inventor. Some curious facts have, however, led many to believe that this explanation is not the true one. It has been discovered that instead of a thin ferrotype disc of iron a thick plate might be used, and it has been asserted that this plate could not possibly bend enough under the influence of the voice to induce currents by its deflections. The word *bend* may be quite inapplicable to such a case, but the surface opposite the magnet does certainly advance and recede, or it would not transmit sound to the air in contact with it. This alternate advance and recess would take place if instead of a 3–8 plate we had a rod many feet or many yards long. A far more singular fact has been discovered by many observers, namely, that non-magnetic and even non-conducting substances might be used instead of a ferrotype disc in the receiving instrument, and lastly, that the receiving instrument will work, though very feebly, with no disc whatever. In this case it seems clear that the Page effect, as it may be called, *i. e.* the noise made by the magnet itself as its particles rearrange themselves with each change of stress, is the source of the sound heard. This sound becomes articulate as soon as its increase and decrease follow the increase and decrease produced by the voice at the sending

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end. It is obvious that when the currents sent are those due to Bell's disc, the sounds from the Page effect must approximately, at least, correspond with those which the ferrotype receiving disc would give off. Thus, when the ferrotype receiving disc is present we hear at least two simultaneous voices, the voice of the disc which is strong, and the voice of the magnet which is weak. When for the ferrotpye disc we substitute a wooden plate, this plate will act as a sounding board for the Page effect. When the plate is a conductor, currents will be induced in it by the change in the magnetic field, and these will tend to move the plate in such a way as to give a third source of sound, which might be called the Ampere effect. A fourth source may be due to the sound produced in the wire itself as the current changes in intensity; this sound was first observed by M. Delarive, and his observations have been lately confirmed by Dr. Ferguson, in Edinburgh.

"Mr. Gott, at St. Pierre, proved that no internal molecular effects are required to explain the action of the telephone, for he attached a sending disc to the coil of one siphon recorder, and a receiving disc to the coil of another siphon recorder. Speaking to the first disc, he caused the coil to vibrate in the strong magnetic field of the instrument, and thus currents were induced which moved the coil of the second instrument; this coil worked its own disc, and was heard to speak plainly. This experiment perfectly corroborates Mr. Graham Bell's explanation of his instrument, but is not in contradiction with the other fact mentioned above, that the Page effect in the receiving instrument occurs simultaneously with what may be called the Graham Bell effect. It must be clearly understood that while the Page effect may be made the means of producing articulate sounds, this can only be done by using Graham Bell's arrangement, and could not be done by any arrangement known before the date of his invention."

[*The complainants produce the original deposition of Prof. Cross in the Harmonic case. Complainants' counsel, Mr. Storrow, states that when the search was first made for it he was not in town; that the deposition has not been in his possession since it was taken, except for a day or two at the time it was taken; and that he understands that since the first search was made during the cross-examination, it was found by Mr. Preble, the examiner who took it, in his safe.*

Complainants' counsel, Mr. Roberts, states that after ascertaining that the said deposition could not be found at Mr. Storrow's office, he went to Mr. Preble and asked him to make thorough search for it, and that upon so doing, Mr. Preble found it in his safe in his (Mr. Roberts's) presence.]

CHAS. R. CROSS.

Attest: CHAS. H. SWAN, *Special Examiner.*

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I hereby certify that I have compared the printed copy of the Harmonic Telegraph Deposition with the original, and such printed copy is a true copy of such original deposition.

CHAS. H. SWAN,
Special Examiner.

BOSTON, Aug. 24, 1885.

Complainants' counsel requests the examiner to note that on Tuesday, May 26, 1885, during the examination of Charles R. Cross, a recess was taken to enable Mr. Cross to attend to his regular duties at the Massachusetts Institute of Technology, and that Cross-Int. 143 *was the first question asked the witness on taking up the examination after such recess.*

And it is so noted.

Attest:

CHAS. H. SWAN,
Special Examiner.

HUGHES, MAY 9, 1878, MICROPHONE ARTICLE.

From Scientific American, Supplement, for June 8, 1878.

[READ BEFORE THE ROYAL SOCIETY, LONDON, MAY 9, 1878.]

ON THE ACTION OF SONOROUS VIBRATIONS IN VARYING THE FORCE OF AN ELECTRIC CURRENT.

BY PROF. D. E. HUGHES

COMMUNICATED BY PROF. HUXLEY, F. R. S., ETC. RECEIVED MAY 8, 1878.

The introduction of the telephone has tended to develop our knowledge of acoustics with great rapidity. It offers to us an instrument of great delicacy for further research into the mysteries of acoustic phenomena. It detects the presence of currents of electricity that have hitherto only been suspected, and it shows variations in the strengths of currents which no other instrument has ever indicated.

It has led me to investigate the effect of sonorous vibrations upon the electrical behavior of matter. Willoughby Smith has shown that the resistance of selenium is affected by light, and Bornstein has led us to believe that many other bodies are similarly affected. We know also that the resistance of all bodies is materially influenced by heat. Sir William Thomson and others have shown that the resistance to the passage of currents offered by wires is affected by their being placed under strains, and, inasmuch as the conveyance of sonorous vibrations induces rapid variations in the strains at different points of a wire, I believed that the wire would vary in its resistance when it was used to convey sound. To investigate this, I made a rough-and-ready telephone, with a small bar magnet four inches long, half the coil of an ordinary electro-magnet, and a square piece of ferrotype iron, three inches square, clamped rigidly in front of one pole of the magnet, between two pieces of board. When using the pendulum beats of a small French clock, or the voice, as a source of sound, I found this arrangement supplied me with an extremely delicate *phonoscope*, or sound detector.

All the experiments detailed in this paper were made with the simplest possible means, and no apparatus of any kind, constructed

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by a scientific instrument maker, was employed. The battery was a simple Daniells cell, of Minotto's form, made by using three common tumblers, a spiral piece of copper wire being placed at the bottom of each glass and covered with sulphate of copper, and the glass being then filled with well-moistened clay and water. A piece of zinc, as the positive element, was placed upon the clay. Insulated wires were attached to each plate, and three of these cells were joined in series. All experiments were made on a closed circuit, the telephone being used as a phonoscope to detect variations in the current, and the consequent reproduction of sound. The apparatus or materials experimented upon were used in the same way as the transmitter of the speaking telephone of Bell. The attached sketch, Fig. 1, will make this clear. B is the battery, S the source of sound or material examined, T the telephone or phonoscope.

I introduced into the circuit at S a strained conductor — a stretched wire — listening attentively with the telephone to detect any change that might occur when the wire was spoken to, or set into transverse vibrations by being plucked aside. Gradually, till the wire broke, the strain was varied, but no effect whatever was remarked except at the moment when the wire broke. The effect was but momentary, but invariably, at the moment of breaking, a peculiar "rush" or sound was heard. I then sought to imitate the condition of the wire at the moment of rupture, by replacing the broken ends, and pressing them together with a constant and varying force by the application of weights. It was found that if the broken ends rested upon one another with a slight pressure, of not more than one ounce to the square inch on the joints, sounds were distinctly reproduced, although the effects were very imperfect.

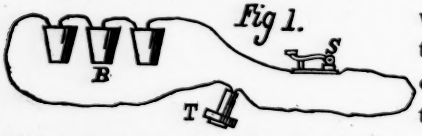

Fig 1.

It was soon found that it was not at all necessary to join two wires endwise together to reproduce sound, but that any portion of an electric conductor would do so even when fastened to a board or to a table, and no matter how complicated the structure upon this board, or the materials used as a conductor, provided one or more portions of the electrical conductor were separated, and only brought into contact by a slight but constant pressure. Thus, if the ends of the wire, terminating in two common nails laid side by side, and

separated from each other by a slight space, were electrically connected by laying a similar nail between them, sound could be reproduced. The effect was improved by building up the nails log-hut fashion, into a square configuration, using ten or twenty nails. A piece of steel watch chain acted well. Up to this point the sound or grosser vibrations were alone produced; the finer inflections were missing, or in other words the *timbre* of the voice was wanting; but in the following experiments the *timbre* became more and more perfect, until it reached a perfection leaving nothing to be desired. I found that a metallic powder, such as the white powder — a mixture of zinc and tin — sold in commerce as "white bronze," and fine metallic filings, introduced at the points of contact, greatly added to the perfection of the result.

At this point, articulate speech became clearly and distinctly reproduced, together with its *timbre;* and I found that all that now remained was to discover the best material and form, to give to this arrangement its maximum effect. Although I tried all forms of pressure and modes of contact — a lever, a spring, pressure in a glass tube sealed up while under the influence of strain — so as to maintain the pressure constant, all gave similar and invariable results, but the results varied with the materials used. All metals, however, could be made to produce identical results, provided the division of the metal was small enough, and that the material used does not oxidize by contact with the air filtering through the mass. Thus platinum and mercury are very excellent and unvarying in their results, while lead soon becomes of such high resistance, through oxidation upon the surface, as to be of little or no use.

A mass of bright round shot is peculiarly sensitive to sound while clean, but as the shot soon become coated with oxide, this sensitiveness ceases. Carbon again, from its surface being entirely free from oxidation, is excellent; but the best results I have been able to obtain at present have been from mercury in a finely divided state. I took a comparatively porous non-conductor, such as the willow charcoal used by artists for sketching, heating it gradually to a white heat, and then suddenly plunging it in mercury. The *vacua* in the pores, caused by the sudden cooling, became filled with innumerable minute globules of mercury, thus, as it were, holding the mercury in a fine state of division. I have also tried carbon, treated in a

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similar manner, with and without platinum deposited upon it from the chloride of platinum. I have also found similar effects from the willow charcoal heated in an iron vessel to a white heat, and containing a free portion of tin, zinc, or other easily vaporized metal. Under such conditions the willow carbon will be found to be metallized, having the metal distributed throughout its pores in a fine state of division. Iron also seems to enter the pores, if heated to a white heat without being chemically combined with the carbon as in graphite, and indeed some of the best results have been obtained from willow charcoal, containing iron in a fine state of division.

Pine charcoal, treated in this manner (although a non-conductor as a simple charcoal), has high conductive powers, due to the iron, and from the minute division of the iron in the pores is a most excellent material for the purpose.

Any one of these preparations, confined in a glass tube or a box, and provided with wires for insertion in a circuit, I call a "transmitter."

Reis, in 1860, showed how, by the movement of a diaphragm, intermittent voltaic currents could be transmitted, agreeing in exact number with the sonorous waves impinging on the diaphragm, and thus reproducing music at a distance, by causing an electro-magnet to vibrate in unison with the diaphragm; and with an iron diaphragm, Graham Bell showed how the vibrations of that diaphragm in front of a polarized electro-magnet could similarly induce magneto-currents, corresponding in number, amplitude, and form with the sonorous vibration, and thus reproduce all the delicacies of the human voice. Edison and others have produced variations in the strengths of a constant current, by causing the diaphragm to press directly upon some elastic conductor, such as carbon, spongy platinum, etc., the varying pressure upon these materials varying the resistance of the circuit, and consequently, the strength of current flowing. Graham Bell and others have produced the same effect, by causing the vibrations of the diaphragm to vary the electro-motive force in the circuit. It will be seen, however, that in the experiments made by myself the diaphragm has been altogether discarded, resting as it does upon the changes produced by molecular action, and that the variations in the strengths of the currents flowing are

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produced simply and solely by the direct effect of the sonorous vibrations.

I have found that any sound, however feeble, produces vibrations which can be taken up by the matter interposed in the electrical circuit. Sounds absolutely inaudible to the human ear affect the resistance of the conductors described above. In practice, the effect is so sensitive that a slight touch on the board by the finger nail, on which the transmitter is placed, or a mere touch with the soft part of a feather, would be distinctly heard at the receiving station. The movement of the softest camel hair brush on any part of the board is distinctly audible. If held in the hand several feet from a piano, the whole chords — the highest as well as the lowest — can be distinctly heard at a distance. If one person sings a song, the distant station, provided with a similar transmitter, can sing and speak at the same time, and the sounds will be received loud enough for the person singing to follow the second speech or song sent from the distant end.

Acting on these facts, I have also devised an instrument suitable for magnifying weak sounds, which I call a *microphone*. The microphone, in its present form, consists simply of a lozenge-shaped piece of gas carbon, one inch long, quarter inch wide at its centre, and one eighth of an inch in thickness. The lower pointed end rests as a pivot upon a small block of similar carbon; the upper end, being made round, plays free in a hole in a small carbon block, similar to that at the lower end. The lozenge stands vertically upon its lower support. The whole of the gas carbon is tempered in mercury, in the way previously described, though this is not absolutely necessary. The form of the lozenge-shaped carbon is not of importance, provided the weight of this upright contact piece is only just sufficient to make a feeble contact by its own weight. Carbon is used in preference to any other material, as its surface does not oxidize. A platinum surface in a finely divided state is equal, if not superior, to the mercurized carbon, but more difficult and costly to construct. I have also made very sensitive ones entirely of iron.

The best form and materials for this instrument, however, have not yet been fully experimented on. Still, in its present shape, it is

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capable of detecting very faint sounds made in its presence. If a pin, for instance, be laid upon or taken off a table, a distinct sound is emitted, or if a fly be confined under a table-glass, we can hear the fly walking, with a peculiar tramp of its own. The beating of a pulse, the tick of a watch, the tramp of a fly, can thus be heard at least a hundred miles distant from the source of sound. In fact, when further developed by study, we may fairly look for it to do for us, with regard to faint sounds, what the microscope does with matter too small for human vision.

It is quite evident that these effects are due to a difference of pressure at the different points of contact, and that they are dependent for the perfection of action upon the number of these points of contact. Moreover, they are not dependent upon any apparent difference in the bodies in contact, but the same body, in a state of minute subdivision, is equally effective. Electrical resistance is a function of the mass of the conductor, but sonorous conduction is a function of the molecules of matter. How is it, therefore, that a sonorous wave can so affect the mass of a conductor as to influence its electrical resistance? If we assume a line of molecules, we know that a sonorous wave is accompanied by alternate compressions and rarefactions. If we isolate the part under compression from the part under dilatation, we vary the dimensions of the mass, and we alter its electrical resistance. In any homogeneous conductor of finite dimensions, the effect of the one will exactly compensate for the effect of the other, and we get no variation of current; but if we break up this homogeneous conductor into a series of minute subdivisions, without actually breaking their electrical continuity, we destroy this neutralizing influence, and we render evident the effect of sonorous vibrations in varying the dimensions of the mass of the conductor, and therefore in varying its electrical resistance, for we reduce the length of a portion of the conductor to a fraction of the length of a sonorous wave. Molecular action, alone, explains to me all the effects produced. Size or shape does not effect them. A piece of willow charcoal the size of a pin's head is quite sufficient to produce articulate speech. I regard the action as follows: If we have two separate conductors, joined simply by contact, this contact offers a certain resistance. Now, we can vary or lessen the resistance by increasing the pressure, thus bringing more points in

contact, or closer proximity. Now, as I employ a constant pressure on the contact, which is exactly under the same influence of the vibrations as the points of contact, more points, or closer proximity, can only be obtained through the molecular swelling or movement of the contact points.

If we assume a line of molecules at the point of contact of the minute masses of conducting matter in their neutral condition to be arranged thus, OOOOO They will appear thus under compression, OOOOO and thus under dilatation, OOOOO In the former case the electrical resistance would be *less*, and in the latter case *more*, than in the normal condition. Hence we should get variation in their electrical resistance. and thus sonorous waves could vary the strength of an electric current, and the variations of the electric current can be made to reproduce sonorous vibrations. These, however, would only produce the result in a certain line, say horizontal; but those perpendicular, while producing the same result, would be a half vibration behind, and thus if two contacts, the one horizontal and the other perpendicular, were on the same piece of charcoal, and the conducting line joined to both, we should have interference. The contrary takes place, as the more contacts we have, and the more varied their direction on the same, the louder and purer the sound becomes. Hence there is no interference, and consequently the whole mass must swell and diminish equally in all directions at the same instant of time.

The tube transmitter, which I exhibit this evening, consists of an exterior glass tube two inches long and one quarter of an inch in diameter. In it are four separate pieces of willow charcoal, each one quarter of an inch long, and two terminals of the same material. The terminals are fastened in the tube, and connect exteriorly with the line and interiorly with the four loose pieces, thus: —

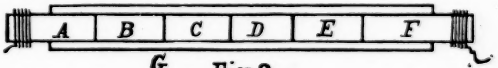

Fig. 2.

Here A is made to press on B, C, D, E, and F, until the resistance offered to the electrical current is about one third that of the line upon which it is to be employed. It may be attached to a resonant board by the ends A or F. If the result was simply due to vibrations,

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we should have A and B making greater contact at a different time from E and F, and consequent interference. If it was a simple shaking or moving of B, C, D, E, and F, it could produce no change, as if B pressed more strongly on C, it would be less on A, and also if the tube was attached by the centre we should have no effect; but if the effect is due to a swelling or enlargement of B, C, D, E, F, it would make no difference where it is attached to the resonant board, as is actually the case. Again, reduce the pressure of A upon B, etc., until they are not in contact, and no trace of current can be perceived by shaking the tube. The instant the sonorous vibrations pass in the tube there is electric contact to a remarkable degree, which could only have taken place by the molecules enlarging their sphere under the influence of the sonorous vibrations.

It is impossible to say what can be the applications of the effects of the discovery which I have had the honor of bringing before the Royal Society, for the whole question has been studied with crude materials, and scarcely sufficient time has elapsed to enable me to consider its ultimate uses. I do not desire to assert that there is anything in what I have brought forward that is superior to or equal to other transmitters used for telephony. It is as loud and far more sensitive than any I have yet heard, and it may be increased by multiplication of transmitting contacts in quantity or intensity; the loudness is at present limited by the capability of the receiver. The materials at my disposal, and the arrangement of them, have not yet been sufficiently studied. I only wished to show that it is possible to transmit clear and intelligent articulate speech, and to render audible sounds which have hitherto been inaudible, by the mere operation of sonorous vibrations upon the conducting power of matter. My warmest thanks are due to Mr. W. H. Preece, electrician to the Post Office, for his appreciation of the importance of the facts I have stated, and for his kind counsel and aid in the preparation of this paper.

I do not intend to take out a patent, as the facts I have mentioned belong more to the domain of discovery than invention. No doubt inventors will ere long improve on the form and materials employed. I have already my reward in being allowed to submit my researches to the Royal Society.

HUGHES, JUNE 8, 1878, MICROPHONE ARTICLE.

From *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, Vol. VI., Fifth Series, July, 1878, pp. 44–50.

ON THE PHYSICAL ACTION OF THE MICHROPHONE.*

BY PROFESSOR HUGHES.

In the paper read on the 9th of May, before the Royal Society, I gave a general outline of the discoveries I had made, the materials used, and the forms of microphone employed in demonstrating important points. I have made a great number of microphones, each for some special purpose, varying in form, mechanical arrangement and materials. It would require too much time to describe even a few of them, and as I am anxious in this paper to confine myself to general considerations, I will take it for granted that some of the forms of instrument and the results produced are already known.

The problem which the microphone solves is this: To introduce into an electrical circuit an electrical resistance, which resistance shall vary in exact accord with sonorous vibrations so as to produce an undulatory current of electricity from a constant source, whose wave-length, height, and form shall be an exact representation of the sonorous waves. In the microphone we have an electric conducting material susceptible of being influenced by sonorous vibrations, and thus we have the first step of the problem.

The second step is one of the highest importance. It is essential that the electrical current flowing be thrown into waves of determinate form, by the sole action of the sonorous vibrations. I resolved this by the discovery that when an electric conducting matter in a divided state, either in the form of powder, filings, or surfaces, is put under a certain slight pressure, far less than that which would produce cohesion and more than would allow it to be separated by sonorous vibrations, the following state of things occurs. The molecules at these surfaces being in a comparatively free state, although electrically joined, do of themselves so arrange their form, their number in contact, or their pressure (by increased size or orbit of revo-

* Communicated by the Physical Society, having been read June 8, 1878.

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lution), that the increase and decrease of electrical resistance of the circuit is altered in a very remarkable manner, so much so as to be almost fabulous.

The problem being solved, it is only necessary to observe certain general considerations to produce an endless variety of microphones, each having a special range of resistance.

The tramp of a fly or the cry of an insect requires little range, but great sensitiveness; and two surfaces, therefore, of chosen materials under a very slight pressure, such as the mere weight of a small superposed conductor, suffice; but it would be unsuitable for a man's voice, as the vibrations would be too powerful, and would, in fact, go so far beyond the legitimate range, that interruptions of contact amounting to the well-known "make and break" would be produced.

A man's voice requires four surfaces of pine charcoal, as is described in my paper to the Royal Society, six of willow charcoal, eight of boxwood, and ten of gas carbon. The effects, however, are far superior with the four of pine, than with either the ten of gas carbon or any other material, as yet used. It should be noted that pine wood is the best resonant material we possess; and it preserves its structure and quality, when converted into the peculiar charcoal I have discovered and described.

It is not only necessary to vary the number of surfaces and materials, in accordance with the range and power of the vibrations, but these surfaces and materials must be put under more or less pressure, in accordance with the force of the sonorous vibrations. Thus for a man's voice, the surfaces must be under a far greater pressure than for the movements of insects. Still, the range of useful effect is very great, as the boxes which I have specially arranged for a man's voice are still sensitive to the tick of a watch.

In all cases it should be so arranged that a perfect undulatory current is obtained from the sonorous vibrations of a certain range. Thus, when speaking to a microphone transmitter of human speech, a galvanometer should be placed in the circuit, and, while speaking, the needle should not be deflected, as the waves of + and — electricity are equal, and are too rapid to disturb the needle, which can only indicate a general weakening or strengthening of the current. If the pressure on the materials is not sufficient, we shall have a

constant succession of interruptions of contact, and the galvanometer needle will indicate the fact. If the pressure on the materials is gradually increased, the tones will be loud but wanting in distinctness, the galvanometer indicating interruptions; as the pressure is still increased, the tone becomes clearer, and the galvonometer will be stationary when a maximum of loudness and clearness is attained. If the pressure be further increased, the sounds become weaker, though very clear; and as the pressure is still further augmented, the sounds die out (as if the speaker were talking and walking away at the same time), until a point is arrived at where there is complete silence.

When the microphone is fixed to a resonant board, the lower contact should be fixed to the board, so that the sonorous vibrations act directly on it. The upper contact, where the pressure is applied, should be as free as possible from the influence of the vibrations, except those directly transmitted to it by the surfaces underneath; it (the upper surface) should have its inertia supplemented by that of a balanced weight. This inertia I find necessary, to keep the contact unbroken by powerful vibrations. No spring can supply the required inertia; but an adjustable spring may be used to ensure that the comparatively heavy lever shall duly press on the contacts

The superposed surfaces in contact may be screwed down by an insulated screw passing through them all, thus doing away with the lever and spring; but this arrangement is far more difficult to adjust, and the expansion by heat of the screw causes a varying pressure. It is exceedingly simple, however, easily made, and illustrates the theoretical conditions better than the balanced lever I have adopted in practice.

In order to study the theoretical considerations, and that with the most simple form of microphone, freed from all surrounding mechanisms, let us take a flat piece of charcoal two millimeters thick and one centimeter square, and after making electrical contact by means of a copper wire on the lower surface, glue that to a small resonant board, or better for the purpose of observation, to a block of wood ten centimeters square. Upon this superpose one or more similar blocks of charcoal, the upper surface in communication with a wire,

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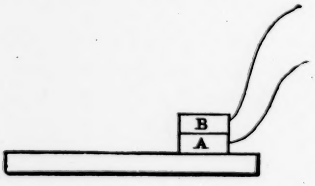
the lowermost surface resting flat, or as nearly so as possible, on the lower block. The required pressure is put on the upper block; and while in this state the two may be fastened together with glue at the sides, or, better, by an insulated screw. The pressure can then be removed, as the screw or glue equally preserves the force. Let the lower piece be called A, and the upper B; when we subject this board to sonorous vibrations, we cannot imagine an undulatory movement of the actual wave-length in such a mass, that is a length comparable with the real wave-length of the sonorous wave, which may be several feet. Nor can we imagine a wave of any length, without admitting that the force must be transmitted from molecule to molecule throughout the entire length; thus any portion of a wave, of which this block represents a fraction, must be in molecular activity.



The lower portion of the charcoal A, being part of the block itself, has this molecular action throughout, transmitting it also to the upper block. How is it that the molecular action at the surfaces of A and B should so vary the conductivity or electrical resistance as to throw it into waves in the exact form of the sonorous vibrations? It cannot be because it throws up the upper portion, making an intermittent current, because the upper portion is fastened to the lower, and the galvanometer does not indicate any interruption of current whatever. It cannot be because the molecules arrange themselves in stratified lines, becoming more or less conductive, as then surfaces would not be required; that is, we should not require discontinuity between the blocks A and B; nor would the upper surface be thrown up if the pressure be removed, as sand is on a vibrating glass. The throwing up of this upper piece B, when pressure is removed, proves that a blow, pressure, or upheaval of the lower portion takes place; that this takes place there cannot be any doubt, as the surface, considered alone (having no depth), could not bodily quit its mass. In fact, there must have been a movement to a certain depth; and I am inclined to believe, from numerous experiments, that the whole block increases and diminishes in size at

all points, in the centre as well as the surface, exactly in accordance with the form of the sonorous wave. Confining our attention, however, to points on A and B, how can this increased molecular size or form produce a change in the electrical waves? This may happen in two ways: *first*, by increased pressure on the upper surface, due to its enlargement; or, *second*, the molecules themselves, finding a certain resistance opposed to their upward movement, spread themselves, making innumerable fresh points of contact. Thus an undulatory current would appear to be produced by infinite change in the number of fresh contacts. I am inclined to believe that both actions occur, but the latter seems to me the true explanation, for if the first were alone true, we should have a far greater effect from metal powder, carbon, or some elastic conductor, such as metallized silk, than from gold, or other hard, unoxidizable matter; but, as the best results as regards the human voice were obtained from two surfaces of solid gold, I am inclined to view with more favor the idea that an infinite variety of fresh contacts brought into play by the molecular pressure, affords the true explanation. It has the advantage of being supported by the numerous forms of microphone I have constructed, in all of which I can fully trace the effect.

I have been very much struck by the great mechanical force exerted by this uprising of the molecules under sonorous vibrations. With vibrations from a musical box two feet in length, I found that one ounce of lead was not sufficient on a surface of contact one centimeter square to maintain constant contact; and it was only by removing the musical box to a distance of several feet, that I was enabled to preserve continuity of current with a moderate pressure, I have spoken to forty microphones at once, and they all seemed to respond with equal force. Of course there must be a loss of energy in the conversion of molecular vibrations into electrical waves; but it is so small that I have never been able to measure it with the simple appliances at my disposal. I have examined every portion of my room, — wood, stone, metal, in fact, all parts, — and even a piece of india-rubber; all were in molecular movement whenever I spoke. As yet I have found no such insulator for sound as gutta-percha is for electricity. Caoutchouc seems to be the best; but I

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have never been able, by the use of any amount at my disposal, to prevent the microphone reporting all it heard.

The question of insulation has now become one of necessity, as the microphone has opened to us a world of sounds, of the existence of which we were unaware. If we can insulate the instrument so as to direct its powers on any single object, as at present I am able to do on a moving fly, it will be possible to investigate that object undisturbed by the pandemonium of sounds which at present the microphone reveals where we thought complete silence prevailed.

I have recently made the following curious observation. A microphone on a resonant board is placed in a battery-circuit, together with two telephones. When one of these is placed on the resonant board, a continuous sound will emanate from the other. The sound is started by the vibration which is imparted to the board when the telephone is placed on it; this impulse, passing through the microphone, sets both telephone-disks in motion; and the instrument on the board, reacting through the microphone, causes a continuous sound to be produced, which is permanent so long as the independent current of electricity is maintained through the microphone. It follows that the question of providing a *relay* for the human voice in telephony is thus solved.

The transmission of sound through the microphone is perfectly duplex; for if two correspondents use microphones as transmitters and telephones as receivers, each can hear the other, but his own speech is inaudible; and if each sing a different note, no chord is heard. The experiments on the deaf have proved that they can be made to hear the tick of a watch, but not, as yet, human speech distinctly; and my results in this direction point to the conclusion that we only hear ourselves speak through the bones and not through the ears.

However simple the microphone may appear at first glance, it has taken me many months of unremitting labor and study, to bring to its present state through the numerous forms each suitable for a special object. The field of usefulness for it widens every day. Sir Henry Thompson has succeeded in applying it to surgical operations of great delicacy, and by its means splinters, bullets, in fact all foreign matter, can be at once detected. Dr. Richardson and myself

have been experimenting in lung and heart diseases; and although the application by Sir. H. Thompson is more successful, I do not doubt that we shall ultimately succeed. There is also hope that deafness may be relieved. For telephony articulation has become perfect, and the loudness increased. Duplex and multiplex telegraphy will profit by its use, and there is hardly a science where acoustics has any direct or indirect relation which will not be benefited. And I feel happy in being able to present this paper on the results obtained by a purely physical action to such an appropriate and appreciative body as the Physical Society.

In conclusion, allow me to state that throughout the whole of my investigations I have used Prof. Bell's wonderfully sensitive telephone instrument as a receiver, and that it is owing to the discovery of so admirable an appliance that I have been enabled to commence and follow up my researches.

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DEFENDANTS' EXHIBIT PROFESSOR CROSS'S HARMONIC TELEGRAPH DEPOSITION.

C. H. S. *Special Examiner.*

[COPY.]

HARMONIC TELEGRAPH CO. ET AL. *v.* THE NEW ENGLAND TELEPHONE CO.

HARMONIC TELEGRAPH COMPANY ET AL. *v.* CHARLES WILLIAMS, JR.

EVIDENCE FOR DEFENDANTS.

TAKEN PURSUANT TO THE SIXTY-SEVENTH RULE OF THE SUPREME COURT OF THE UNITED STATES IN EQUITY, AS AMENDED, BEFORE ME,
W. P. PREBLE, JR., *Examiner.*

Present: CAUSTEN BROWNE, Esq., *of Counsel for Complainants.*
CHAUNCEY SMITH, Esq., *and* J. J. STORROW, Esq., *of Counsel for Defendants.*

[It is agreed that the same deposition shall be considered as taken in both the above-named cases.
Attest: W. P. PREBLE, *Examiner.*]

DEPOSITION OF CHARLES R. CROSS.

BOSTON, June 18, 1879.

Direct Examination by J. J. STORROW, Esq., *of Counsel for Defendants.*

Int. 1. Please state your name, age, residence and occupation.

Ans. Charles Robert Cross; thirty-one years; Boston, Mass.; Thayer Professor of Physics in the Massachusetts Institute of Technology.

Int. 2. Have you, before 1874, ever used any apparatus for sending audible melodies or musical tones produced by currents of electricity sent from the transmitting station? If so, describe such apparatus as you have used, and what use you or others have made of it, within your knowledge, before 1874, and when and where such use took place.

Ans. Previous to 1874, I occasionally used the receiver of the Reiss telephone, with a tuning fork as a transmitter, arranging the apparatus in the ordinary manner. In February, 1872, I exhibited another form of apparatus, designed to accomplish the same end, at a lecture given before the pupils of the New England Conservatory of Music. The apparatus made use of the principle previously employed by Prof. E. C. Pickering, then of the Institute of Technology, in an experiment privately performed. In the apparatus as exhibited by me, a horse shoe electro-magnet was placed upon a wooden box so that its poles were close to the exterior of a large tin box, which is here present, but not quite touching it. The magnet was placed in an electric circuit with a battery of six small Grove cells, a tuning fork being also placed in the circuit, so arranged that, on vibrating the fork, the current was made and broken a great number of times a second. The sound of the tuning-fork was reproduced by this receiver, and the sound from the receiver was perfectly

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audible throughout my lecture room. In the last part of December, 1873, and the first week in January, 1874, a number of other experiments were tried, and a second exhibition of the instrument was made on Jan. 7, 1874, at a lecture in one of the Lowell free courses, at the Institute of Technology. In the latter experiments, several forks were tried separately, and the receiver reproduced the characteristic pitch of each. But one fork was, however, used publicly in the lecture. At certain times during the experiments, the magnet touched the box, in which case the sound persisted, but was less loud.

Int. 3. Does that apparatus exist now in the same condition as when you used it, and if so, where does it belong, and is it here present?

Ans. The separate portions of the apparatus still exist, belonging to the Institute of Technology. The different portions of the receiving instrument are those which are here at present. Two binding screws have been added to the magnet since the date when the experiment was performed.

Int. 4. Was this magnet and the wooden box on which it rested and the large tin box made for the purpose of this exhibition, or where did you get them?

Ans. None of the portions of the apparatus in question were made for the exhibition. The electro-magnet was one which had been for some years in the possession of the Institute. The large tin box was one in which some apparatus had been imported a year or more previous to the date of the experiments. The wooden box which was used, was one which was convenient for use as a stand upon which to place the electro-magnet. I cannot say that the wooden box present to-day is the identical one then used.

Int. 5. What led to the preparation of this apparatus, and for what purpose was it prepared?

Ans. I took up the subject chiefly to be able to show in my lectures an instrument which would give louder sounds than the Reiss receiver would produce with the transmitter which I used.

Int. 6. You say that this apparatus was suggested by a previous experiment of Professor Pickering; state what you know of that experiment before you made this apparatus.

Ans. The experiment was performed as early as 1870. I was not present at the time, but the experiment was described to me on the following day. The receiver was a tin plate or box, which I saw afterwards myself. I cannot say positively whether it was a plate or a box which I saw, or whether there was or was not an armature attached. The transmitter, as I was informed at that time, was a sonometer to the wire of which a small wire acting as a circuit breaker was attached, and the whole so connected with the battery that on causing the wire of the sonometer to vibrate, the circuit was made and broken with great frequency. The effect of this was

to produce a loud noise at the instrument used as a receiver, while the sonometer wire was vibrating. The description was given to me by Mr. Waldo Ross of this city, who was present at the experiment, and I think also by Professor Pickering. The box used in my later experiments was not the one made use of in the earlier experiments of Professor Pickering.

Int. 7. When this experiment of Professor Pickering was described to you at the time you have stated, were you informed in what position the tin box or plate was placed with reference to the poles of the magnet, and if so, what were you informed on the subject?

Ans. All that I distinctly recollect is that the magnet was so placed that its poles were very near to the metal of the plate or box.

Int. 8. Have you recently, with the receiving apparatus which you constructed in 1872, and which is here present, tried to transmit and reproduce audibly articulate speech or the sound of musical instruments transmitted by means of electricity from a distant station? And if so, describe what you have done in that respect, and with what results?

Ans. On the tenth of June, 1879, I tried a number of experiments with this receiver, which was set up in a manner similar to its arrangement in the exhibition already mentioned, it being in the office of Mr. J. J. Storrow, Union Building, State Street, Boston. It, together with a Blake transmitter, was connected in the primary circuit of a battery, the transmitter being placed in room 42, in Union Building, and connected with the receiver by wires stretching across the open court separating these two rooms, and about one hundred feet in length. A second circuit containing two ordinary hand telephones was stretched between the two rooms, so that any messages sent by the apparatus which I am describing could easily be verified.

The magnet in these experiments was placed near to the outside of one end of the tin box, which rested upon its side, and when faint sounds were transmitted, the head was placed inside the box, with the ear opposite the poles of the magnet, in order to detect these sounds. I first asked Mr. Watson, who was assisting me, to play a small mouth harmonica before the mouthpiece of the Blake transmitter. I was expecting to hear the sound given by that instrument, and so was somewhat surprised to hear loud and clear notes resembling those of a music box On inquiring of Mr. Watson what instrument he had been using, I was informed that he had been transmitting the sound produced by a child's music box, which he happened to have there. Afterwards the mouth harmonica was substituted, and its characteristic notes clearly perceived. In both of these cases, the characteristic pitch and quality of the tones in the musical instruments used could be heard at the distance of eighteen inches or more from the receiver. Mr. Watson was then asked to

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speak into the transmitter, and while the ear was still at a distance of about fifteen inches from the receiver, a sound was heard, which was recognized as articulation, although the words could not be distinguished at that distance. I then placed my ear close to that portion of the box which was opposite the poles of the magnet, and asked Mr. Watson to speak into the transmitter. I then without difficulty was able to hear a number of sentences, which were entirely unexpected to me.

Int. 9. Please state whether on this occasion you also tried to transmit articulate speech, using as a receiver a common hand Bell telephone connected upon the circuit with the mouthpiece and ordinary diaphragm removed, and the instrument held against one end of the tin box, so that the box should take the place of the diaphragm; and if so, with what result.

Ans. I did. With it we succeeded in transmitting articulate speech from one station to the other with very great ease.

Int. 10. Will the Institute of Technology give or sell the defendants the receiving apparatus you constructed, to be filed as an exhibit in this case; and if not, will you please produce duplicates of said tin box and horse shoe electro-magnet, and a wooden box like the one used in your experiment?

Ans. These early experiments have so much interest attached to them that it seems desirable to retain the original apparatus in the possession of the Department of Physics. I will produce duplicates.

[*Defendants offer in evidence duplicates of the tin box, horse shoe electro-magnet and wooden box, marked "Defendants' Exhibits* 1, 2 *and* 3 *Cross Metallic Diaphragm Magnet Receiver, W. P. Preble, Jr., Examiner."*]

Int. 11. Do you expect immediately to go away; if so, how soon, and for how long?

Ans. I expect to leave for Europe on Saturday next, to be gone until the latter part of September.

[*Adjourned to June* 19.]

BOSTON, June 19, 1879.

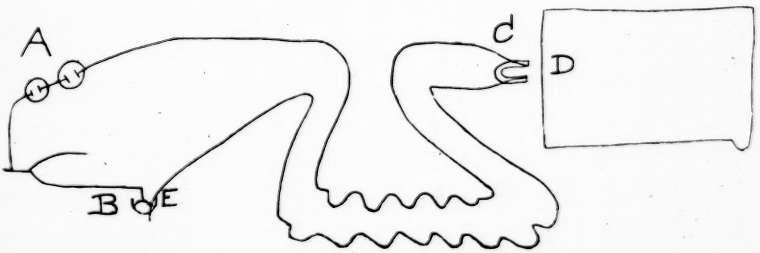
Int. 12. Have you any way of fixing the dates given in your second answer other than by memory; if so, state what it is.

Ans. The date of the earliest exhibition, February, 1872, is indicated upon my notes used at the lecture given at that time. That the second public exhibition was given at the date assigned, I know from the fact that it was given in the first of a course of lectures on sound; a reference to the advertisements of that course gave me the date which I assigned, Jan. 7, 1874.

Int. 13. Please to produce, as part of your answer, a diagram illustrating the mode in which you connected up the tuning fork and the Cross Metallic Diaphragm Magnet Receiver in the exhibitions at the Institute of Technology, referred to in your deposition.

Ans. I produce it.

EXHIBIT 4.



A. Battery.
B. Tuning-fork circuit-breaker.
C. Electro-magnet.
D. Tin box.
E. Mercury cup.

Int. 14. Please also produce, as a part of your answer, a diagram of the manner in which you connected up the said receiver with the Blake transmitter, in the experiments in which you transmitted articulate speech and musical tones on June 10, 1879, to which you have testified in this deposition.

Ans. I produce it.

A. Battery.
B. Blake Transmitter in main circuit.
C. Magnet.
D. Tin box.

(Signed) CHAS. R. CROSS.

(Signed)
Attest: W. P. PREBLE, Jr., *Examiner.*

I hereby certify that I have compared the printed copy of the Harmonic Telegraph desposition with the original, and such printed copy is a true copy of such original desposition.

CHAS. H. SWAN,
Special Examiner.

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UNITED STATES CIRCUIT COURT.

SOUTHERN DISTRICT OF NEW YORK.

AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, ET AL.	In Equity.

UNITED STATES CIRCUIT COURT.

DISTRICT OF NEW JERSEY.

AMERICAN BELL TELEPHONE COMPANY, vs. THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, ET AL.	In Equity.

UNITED STATES CIRCUIT COURT.

EASTERN DISTRICT OF PENNSYLVANIA.

AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. PENN OVERLAND TELEPHONE AND TELEGRAPH COMPANY, ET AL.	In Equity.

Testimony on the part of the defendants in the above stated cases in reply to complainant's proofs in reply taken before me by consent on this fifteenth day of October, 1885, at Temple Court, New York City.

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Present:

MESSRS. E. N. DICKERSON AND
J. J. STORROW, ESQS.
for Complainants.
A. Q. KEASBEY, ESQ.,
for Defendants.
C. N. WILLIAMS,
Special Examiner.

John R. Paddock, recalled, having been previously sworn, testifies as follows:

Examined by Mr. Keasbey:

Int. 1. Have you read the testimony of Prof. Charles R. Cross given in the Dolbear case relating to the Reiss instruments, and to the publications pertaining thereto?

Ans. I have.

Int. 2. Referring now to page 273, Int. 16, of that testimony—will you state what was the weight of the "hopping electrode" in the Reis instruments which was found by you to be best adapted to transmit articulate speech, and also what relation the anvil electrode of modern transmitters bears to this hopping electrode of Reis?

Ans. In the experiments with the Reis transmitters I obtained the best results as regards articulate speech when the so-called "hopping electrode" weighed 20 grains or less, in one case 16 grains, and in another case 13 grains. When carbon was substituted for the other platinum electrode I found that a much heavier hopping electrode could be used to obtain the same result, but with both of platinum as in the original Reis transmitters, the above weights were found to be the best adapted to transmit either musical sounds or articulate speech.

As regards the weight of the anvil piece in modern transmitters, it is of no value as a standard when applied to the Reis transmitters, for in all modern transmitters carbon is used which admits of greater pressure and the manner of suspension being vertical or nearly so, only a fraction of the total weight rests upon the diaphragm.

Int. 3. From page 277—interrogatory 24 of this testi-

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mony, I read as follows: "Assuming that the Reis transmitter, as a structure, is to-day capable of producing to some extent electrical undulations similar in form to the sound waves, in the hands of those who have learned what was taught by Mr. Bell's patent, and by the subsequent invention of the articulating microphone transmitter, &c." In regard to this assumption, will you state from your practical work with those instruments, what knowledge is necessary to enable the operator to obtain articulate speech by or through them?

Ans. Judging from what I have seen and know of the actual operation of the Reis instruments, I am of the opinion that they are to-day capable of transmitting speech not because "we have been taught by Mr. Bell and subsequent invention how to use them," but because the mode of operation by which they now operate is inherent in them, and all the knowledge necessary, is that of a skilled workman familiar with electrical apparatus, and the laws of electricity, who being given these instruments and told to make them transmit speech—works at them until he does it, without regard to the theories of their mode of operation.

Int. 4. Referring now to page 278, I read as follows: Int. 26. "Do you find in any of the publications made by Reis himself, anything which shows that he understood that difference in 'form' between vibrations which gives to each sound its quality as you have explained in your first affidavit? Ans. I do not find in any of Reis' papers any statement showing that he understood the nature of musical quality. He apparently had only the indefinite ideas which were popularly current when he wrote." Do you find anything in the publications referring to Reis which would show that he did understand the nature of musical quality, and if so, what and where is it stated?

Ans. Philip Reis, in his lecture before the Physical Society, at Frankfort A. M., 1860–1, shows an intimate knowledge of Helmholtz's theories at that time, he there explains in detail the composition of musical tones and

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chords, and he does not fail to recognize the overtones of musical tones which constitute an important feature in articulate sounds, and he shows them to enter into the composition of vowel sounds; according to the experiments of Willis & Helmholtz; he says his instruments transmit these same vowel sounds an a faint and imperfect manner as yet. The Reis-Legat article says the same thing. Quality is understood to be that peculiarity in sounds by which we distinguish one kind of musical instrument from another, or one person's voice from another person's voice; it is often called "timbre," or (Klang-farbe) sound-color. In this connection I find in the Deutsche Industrie Zeitung, 1863 (defendants' exhibits, Molecular case, pp. 83), the following: "A friendly communication was sent us some time ago by Mr. J. F. Quilling, of Frankfort A. M., according to which the capacity of the apparatus to transmit tones to a considerable distance clearly, and with their characteristic timbre (Klang-farbe), is fully established. They succeeded so well with the tones that were sung, that not only were the melodies of songs reproduced distinctly and perfectly at a tolerably remote station, but known voices could be recognized.

"All present capable of judging, Mr. Q. adds, who availed themselves of the opportunity of witnessing the experiment, agreed that the possibility is before us of making one's self understood verbally at any distance in the way shown by Mr. Reis." Also in the Annual Report of the Physical Society of Frankfort on the Main, 1860–1 (defendant's exhibits, Molecular case, pp. 72), I find as follows:

"It is not possible thus far to reproduce spoken tones (tonsprache des menschen) with a distinctness satisfactory to all. The consonants are, for the most part, distinctly reproduced; the vowels not in the same degree." The author attempts to explain this imperfect reproduction of the vowels by saying that the apparatus reproduces the vibrations to a certain extent indeed, with proportionate, but also reduced strength, and the ear can no longer satisfactorily dis-

cern the relation of the proportionately great vibrations which determine the pitch (tonhohe) to the small vibrations on which vocal quality (vocal farbe) depends.

Int. 5. In this testimony, on page 287, certain instruments are put in evidence marked "Defendants' exhibits, Reis Transmitter, first form; W. A. C., examiner," and witness is asked to compare them with that first form described in the Reis lecture of 1861; have you read this part of the testimony?

Ans. I have.

Int. 6. And did your experiments with the Reiss Frankfort instruments, concerning which you testified on the 19th of last September, confirm the opinion here stated as to the manner in which those original instruments were supposed to have been made to operate?

Ans. They did not; and I would say that after having seen and used those instruments I am of the opinion that the results as given in that lecture, such as "Melodies transmitted, complete chords of three tones, consonants reproduced for the most part pretty distinctly, but vowels as yet not in an equal degree," could not have been obtained if the "thin strip," called the hammer-like wire, had been rigidly fixed so as to have had no tendency to follow the membrane when it retreated; when thus rigidly fixed by us in our experiments no musical tones could be transmitted. By loosening the binding screw so as to give this "thin strip" more freedom of movement, melodies were transmitted by us, and also speech.

Int. 7. Do you find anything in the description of those instruments which would indicate that the "thin strip" referred to was intended to have this freedom of movement?

Ans. The description says that "at the first condensation the hammer-like wire (*d*) is pushed back, and that at the rarefaction it cannot follow the retreating membrane;" in order to be pushed back by the slight force of an air vibration generated by a musical instrument, or by the voice in "singing, not very loud," this hammer-like wire must have been supported in a very light and elastic manner; even

when so supported it cannot follow the retreating membrane quickly enough, and lags behind, and the description states the current is broken.

Int. 8. In your answer to interrogatory 6, you stated that in your experiments you loosened the binding-screw, so as to give more freedom of motion to the hammer piece; did you in those experiments put that hammer piece under tension, so as to compel it to follow the retreating membrane without parting from it?

Ans. I used no means to put the hammer piece under such tension. In the instrument used by us this hammer piece had been curved or bent where the binding post passed through it, and when this post was screwed down the contacts were pressed together; by loosening the post freedom of motion was restored to the hammer piece and it would operate.

Defendants' counsel offers in evidence an article from the *Scientific American* of April 18th, 1885, from *La Lumière Electrique*, by De Locht Labye, marked defendants' exhibit De Locht Labye article.

Also an article from the *London Electrical Review* of October 3d, 1885, p. 290, being an article by J. Monro, in *La Lumiere Electrique*, entitled "Some Thought About the Telephone," marked defendants' exhibit Monro article.

Complainant's counsel object to the articles as incompetent on their face, and especially object to the article by De Locht Labye, upon the ground that he is an interested party, and interested as defendant in a suit pending in France, under the French Bell Patent.

The defendants' counsel replies to the objection, that the articles in question are put in in reply to

articles from the *Scientific American* and the *Telegraphic Journal* and *Electrical Review*, and the Lecture of Mr. William H. Priece, put in by the complainants, and that if the complainants' regard such articles as incompetent evidence and will withdraw the three articles alluded to, the defendants will also withdraw these two which are in reply.

The complainant's counsel reply that the articles put in by them were the first articles published and accessible in scientific literature, which introduced the speaking microphone to the world, and are put in to show the historical origin of that instrument, and the purposes and views of those who so introduced them to public notice in printed publications.

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Defendant's Exhibit, De Locht-Labye Article.

DE LOCHT-LABYE'S HAMMER TELEPHONE.

WHILE speech is reproduced in the Bell telephone by the inflections of a very thin disk of iron or steel, in my apparatus it is a *block* of wood, a piece of hard rubber, or even cork, that emits the sounds. These substances are inflexible by reason of their thickness. This observation suffices to show that the operation of my telephone essentially differs from that of Bell's. The American inventor has even asserted that it is impossible to transmit speech by such means. The hammer telephone substituted for the Bell in telephone stations in no wise cedes to the latter as regards force and the clearness of the words transmitted.

I reproduce this apparatus herewith in plan and section in Figs. 1 and 2.

A horseshoe magnet, CC, carries at its poles two small soft iron cores, in which are enchased two bobbins, DD, of insulated copper wire. A single bobbin is sufficient, however. The magnet is affixed in an invariable manner to the wooden support, AA, that serves as a frame for the entire apparatus. Opposite the poles, NS, in contact with one of them, and at a very short distance from the other (which carries the bobbin), there is an armature, *n f s*, formed of a small, thick, inflexible soft iron or magnetized steel bar. This armature is connected with a stiff lever, *f g*, that oscillates freely around a fixed axis, *o o*, arranged upon a small brass support, *p p*. As may be seen, the lever armature has the arrangement of the rigid and inflexible beam of a balance, and in no wise partakes of the nature of a thin and flexible disk. It is connected with the support only through its fixed axis, and is attached to no membrane, disk, or piece whatever. The lever terminates at the end opposite the armature in a small hammer, H, of metal or other material, fixed to the extremity of a regulating screw, V.

In its normal position, this hammer bears against a thick, rigid, inflexible piece, M (of wood, glass, metal, slate, or any other material), which, for elegance and convenience, has been made cylindrical. Upon this piece is superposed the mouth-piece, KPPK.

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The position of the lever armature is determined by the magnetic attraction of the poles of the magnet. To this force is opposed the reaction of the fixed obstacle upon which the hammer rests.

By the aid of the screw, V, which carries the hammer, the distance between one of the ends of the armature and the pole of the magnet that carries the bobbin can be easily regulated so as to obtain a maximum performance.

In one of the apparatus that I experimented with, the rigid disk against which the hammer bore was a block of fir-wood, with an *unplaned* under surface. This block was $\frac{4}{10}$ inch thick. It would not occur to any one to assert that such a piece could bend under the action of sonorous waves.

The hammer telephone may be employed in the double capacity of transmitter and receiver or reproducer of speech. It was by giving it this double capacity that, in a recent experiment performed along with the engineers of the Belgian administration of telegraphs, conversation was transmitted, without the assistance of any pile transmitter, between Anvers and Brussels, through a line resistance representing 79 miles of telegraph wire.

The operation of my apparatus as a transmitter leads to a remarkable conclusion as regards that of microphone transmitters, and particularly of the pantelephone, an apparatus of my invention that was much appreciated at the last Exhibition of Electricity.

In order that an electric current may be produced in the bobbin that surrounds the pole of the magnet of the hammer telephone employed as a transmitter, without the aid of an electric battery, it is necessary, according to the principle of Faraday on magneto-electric induction, that the magnetic armature shall perform a mechanical motion in the magnetic field of the magnet. It therefore results, on the evidence of the experimental fact of transmitting speech by the hammer telephone, that the emission of words in front of the mouthpiece of the apparatus brings about mechanical motions of the lever armature, and that too despite the magnetic force of the magnet, which tends to keep the lever immovable.

Now, if in this apparatus, of which all the parts are relatively slightly movable, we can, by emission of sounds, cause motions in the lever armature, we have stronger reason for admitting that, in transmission by the pantelephone, we set

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in motion the essentially movable disk suspended like a pendulum, and consequently that there is produced through the emission of speech a series of breakings of the contact that existed between the carbon of the movable disk and the fixed platinum stop of the apparatus. This irrefutable conclusion brings into relief the essential difference between the pantelephone and the Edison transmitter, in which a continuity of the circuit is absolutely necessary, according to the assertions of the inventor himself.

If fact, Mr. Edison, at the beginning of the description of his patent, expresses himself thus: "I find that it is impossible to open and close the line circuits in apparatus for transmitting the human voice; the line circuit must be always closed, and the transmission be produced by an increase or diminution of the electric tension resulting from the more or less resistance in the line." Mr. Johnson, Edison's assistant, called as a witness by the United Telephone Co., in the Edinburgh telephone trial, confirmed this assertion of Edison's.

"The greatest difficulty that we had to solve," said he, "was to maintain a continuity in the circuit, and different modifications were made for maintaining the contact by the use of springs of different forms, and of weights and screws, and other arrangements, all devised for the purpose of allowing the diaphragm to undergo the desired vibrations without breaking the circuit."

The well known laws of mechanics relative to the motions of bodies that are struck make the operation of the hammer telephone perfectly understood: (1) There is an independence of motion between the striking body and the one struck. (2) The motions of the bodies depend, in duration and amplitude, upon their own elasticity and upon the connections with the system. (3) If two bodies in contact have different mobilities, every shock applied to the system will cause different motions, *i. e.*, a relative motion of one body with respect to the other, and consequently a momentary separation of the two bodies.

One peculiar example of the different motions produced by shock is found in the experiment with ivory balls of equal bulk suspended in a row, one after the other. When the first is raised and allowed to strike against the second, the latter, as well as all the following, remains absolutely immovable, and the last of the series is the only one affected. Something analogous to this must occur in the transmission of the

shock of the sonorous wave against the diaphragm of the hammer telephone. This, like the intermediate ivory balls, remains relatively immovable, and transmits motion through its mass to the hammer at the end of the lever. Through this motion there occurs a momentary breakage of contact between the two bodies. The armature leaves the pole, and returns to it at once through the effect of attraction.

It is by a series of hammer blows against the fixed obstacle that I also explain the reproduction of sounds in receiving. The electric currents traversing the bobbin cause rapid motions of the lever, which, on each return to its initial position, strikes a series of blows against the fixed side. What confirms this view is that the reproduction of sound is not prevented by the interposition of deadening materials between the hammer and fixed obstacle, such as blotting paper of several thicknesses, kid skin, cloth, and felt, even.

It could not be claimed that inflections of these non-sonorous matters can produce sound. Moreover, if we substitute flexible disks of mica or metal for the thick and rigid disk, the apparatus will scarcely operate any longer.

This result of the analysis of the operation of my telephone has led me to make a profound study of the theory at present admitted, in order to explain the telephonic transmission of articulate sounds

As well known, the author of this theory is the inventor of the telephone itself. What is not generally known is that the Boston professor, Graham Bell, began by building the theory, and that his wonderful apparatus was only realized by him through the application of his theoretical ideas, and seems to be the faithful translation of them. From this it is not astonishing that Bell's theory of continuous and undulatory currents has been universally conceded by the scientific world.

The new theory of the transmission of sounds by discontinuous currents was not conceived by me until after the invention of the hammer telephone, whose working could not be explained by Bell's theory. This mode of proceeding *a posteriori* is without doubt more favorable for the discovery of the truth.

The abrupt motions of the lever armature cause the emission upon the line of a succession of electric currents that last a very short time, and these, upon entering the bobbin of

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the receiver, produce in turn abrupt motions of the lever armature, followed by shocks against the rigid piece, MM.

In support of his theory, Bell drew a series of diagrams which it is easy to criticise. They appear to me to contradict the facts observed, and cannot therefore be a true representation of the phenomena. Bell's theory of undulatory currents is contradicted by experience, and cannot be applied to the operation of his own apparatus. Bell has established between articulate and musical sounds an essential distinction, which, in my opinion, is not admissible. There is no difference in nature between the different sounds. Both are due to vibrations that succeed one another in a sonorous body. The only difference between a musical and an articulate sound is that in the first the component vibrations are equally spaced, while the intervals between the vibrations that form words are entirely unequal.

For the telephonic transmission of speech it is not necessary, as Bell asserts, that there shall be a continuity of current in the line whose variations in intensity are the facsimile of the sonorous waves of air vibrating through the emission of words; but it is necessary and suffices, as I shall hereafter prove, that the *discontinuous* electric currents which succeed one another in the line shall be equal in number with that of the sonorous vibrations, that their intensity shall be proportional to that of such vibrations, and that the interval between the currents which succeed one another shall be perfectly equal to those which separate the sonorous vibrations. Upon this condition, human speech in all its modulations, and all kinds of sounds, will be electrically transmitted and perfectly reproduced, if, at the receiving station, there is a Bell apparatus or a hammer telephone capable of being influenced by currents of different intensities that succeed each other at precise intervals.—*Leon De Locht-Labye, in La Lumiére Electrique.*

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Defendant's Exhibit, Monro Article.

SOME THOUGHTS ABOUT THE TELEPHONE.

The discovery of the microphone by Prof. Hughes, and the construction of metal microphones capable of transmitting speech, have altered the aspect of the question affecting the originality of the ordinary telephonic transmitters in use. It is now seen that the crude transmitting apparatus of Reis, however imperfect in a practical sense for the purpose of speaking to a distance, does of necessity contain the practical principle of the microphone, although Reis himself may not have been entirely aware of it. He did not discover the microphone, pure and simple, operating with a tympan, and as a general property of loose contacts between conductors traversed by an electric current; but he hit upon a form of microphone combined with a tympan, which acted as a current regulator, and was capable of transmitting spoken words or parts of words. The discovery of the true microphone remains with Prof. Hughes, in spite of what both Reis and Edison did, because he elucidated the whole subject, and the conditions of microphonic action, besides inventing apparatus which operated in a different manner, *i. e.*, without the use of a tympan and under the direct action of the air, or through molecular vibration of a body as distinct from tympanic pressure. He also showed how, by his delicate microphonic contacts, these vibrations could be rendered audible, and sounds, as it were, magnified. But the discovery of even an imperfect microphone in combination with a tympan by Reis, and designed for the purpose of transmitting sounds and speech, has an important bearing on the claims of Edison for originality in the "carbon transmitter," which is virtually a microphone in combination with a tympan. If the practical principle was contained in the apparatus of Reis, it follows that Edison is not the first and true inventor of a microphonic transmitter combined with a tympan, and that his original invention is limited to details of construction, the use of plumbago, &c. It also follows that other inventors are free to use the principle in question, with modifications of detail introduced by them, provided such details are not those invented and protected by Edison.

If the practical principle of an invention is public property, it stands to reason that it is only in the method of carrying it out that any subsequent improvement can be claimed as a new invention.

Let us consider this point at greater length. The Edison patent, which holds the ground against so many microphonic transmitters, claims "the combination of a diaphragm or tympan with *a tension regulator*, substantially as described." In some recent forms of transmitter there is no tympan in the ordinary sense; but the point may be disputed in a court of law. It therefore appears that if the Edison patent be held to include all kinds of tension regulators, whether of carbon or metal, in combination with a diaphragm, it must also include the platinum transmitter of Reis, which can be regarded as a platinum microphone combined with a tympan. It is true that the combination claimed by Edison is specified to be "in a closed circuit," and it is usually believed that Reis's instrument interrupted the circuit. But this is only true in part. One of Reis's instruments (date 1860–61), as a look at it will show, had a spring pressing on the contact as if to keep it close, and it could also be worked without breaking the circuit, as perhaps, it did. The fact that Reis obtained words through it showed that it acted sometimes as a microphone, or true tension regulator in the Edisonian sense. It matters not that Reis himself did not fully understand its working, and spoke of interruptions. The instrument was there, and we can now understand better than he how it works. I have heard words transmitted by the platinum contacts of a transmitter which was simply a copy of Reis's instrument. It follows that Reis's transmitter, being a microphone when the sounds were not too strong to interrupt its circuit, antedates the Edison patent, and invalidates its claim. This is a view of the case which might legitimately be advanced on fair grounds, and which on due consideration must recommend itself to an electrical expert, whatever he may think of it at first.

One can admit that Reis did not *publish* the microphonic principle as Prof. Hughes did, and that he probably did not realize its existence, although it must to a certain extent have operated in his instrument, judging by his results, and the actual microphonic construction of the apparatus. But Edison himself does not appear to have realized or published the

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microphonic action at work in his original carbon transmitter. On the contrary, he seems to have regarded its operation as due to an inherent property that plumbago possessed of varying its resistance under pressure. It was Hughes who discovered the peculiar microphonic principle of a loose or imperfect contact, and this fact ought never to be forgotten. It was only after Hughes's discovery (which applied to metals as well as carbon, conductors as well as semi-conductors), that Edison's instrument was seen and shown to work on the microphonic principle; and the Blake instrument, if not also the carbon button instrument, were fashioned by the light of Hughes's discovery.

It follows that if we allow Edison's instrument to be a form of microphone, we must also allow Reis's 1860–61 instrument to be another form of microphone. Both of them consist of tympans in combination with tension regulators. The use of carbon in one, and metal in the other, has nothing to do with the question, for since Prof. Hughes's discovery, and the construction of actual speaking instruments with metal instead of carbon contacts, it is known that metals also make tension regulators. The weakest point in the argument is that Reis's instrument did not always work in a closed circuit; but this is a question of degree rather than of kind. With louder sounds the circuit would be interrupted, with feebler sounds it would remain "closed" in the sense that the current would not be quite broken, though "regulated" in strength. The circuit of a "Blake" transmitter could also be broken if one spoke loud enough. Every microphonic arrangement is liable to interruptions of the circuit by loud sounds; and the spring in the Blake instrument which presses the contact surfaces together has its exact counterpart in the spring which Reis employed to press his platinum surfaces in contact. In fact, the Reis 1860–61 transmitter is essentially a microphone like the Blake. It has all the elements of the Blake instrument, tympan, contact points, and spring adjustment. Substitute hard carbon for one of the contacts in the Reis instrument, and you have substantially a Blake transmitter.

The reason why the Reis contacts are so apt to open the circuit, as compared with the contacts of the Blake, is that they are both of platinum. Had one been of carbon this difficulty would have disappeared, and M. Reis would have thoroughly succeeded in producing a practical telephone. He

would, in fact, have completely anticipated both Edison and Bell. As it was, he failed from the materials he used, rather than in principle. I have found from experiment that metal contacts, and especially platinum ones, are very apt to open the circuit under the vibrations of the voice, and the reason probably is that the "arc" or air discharge which connects them when they are vibrated is very short; shorter than in the case of carbon, if not some other metals. Hence, in order to preserve the continuity of the circuit, the vibrations of the voice must be much feebler than in the case of carbon. This was the chief difficulty in the way of Reis; a difficulty of detail, and not of principle. We have metal contacts now which overcome it, without having to resort to carbon at all.

The chief points of the argument, then, as set forth above, are as follows:—

1. In 1860-61 Philip Reis constructed a telephonic transmitter with platinum contacts, and a receiver consisting of an electro-magnet with a thin iron armature in front of its poles, and vibrated by the current. (See Silvanus Thompson's work, entitled, "Philip Reis, Inventor of the Telephone," for a full description of the apparatus).

2. The Reis receiver is essentially a Bell receiver, the difference between them being one of detail.

3. The Reis transmitter is essentially a metal microphone; of an imperfect construction, it is true, but still a microphone. The metal used was platinum.

4. Edison's transmitter is essentially a carbon microphone. Blake's transmitter, which is a form of Edison's, is a carbon and platinum microphone.

5. Reis's microphone was combined with a tympan, so is Edison's and Blake's.

6. Being a microphone, Reis's transmitter is a "tension regulator" of essentially the same nature as Edison's and Blake's; the difference consisting mainly in the materials used, and being one of degree rather than of kind. Both can operate "in a closed circuit," provided the loudness of the voice is graduated to suit each instrument.

7. Therefore Edison's claim for *the combination of a tympan with a tension regulator in a closed circuit*, is anticipated by the Reis transmitter (and cannot be sustained).

The claim of Edison is, in fact, too comprehensive—fatally so. Had he confined his claim to the use of lamp-black,

plumbago, or even semi-conducting materials (as he did originally in his English patent before it was amended to make it more sweeping), for his "tension regulator," it might have been more secure; because we do not know that Reis used such materials. But, in extending it, he has brought his claim into antagonism with the earlier work of Reis.

There is no need to dwell upon the work of Prof. Hughes, because it is his discovery which has thrown light upon the whole subject. Moreover, it was apparently Prof. Hughes who showed Edison himself, and likewise Blake, that hard carbon contacts were preferable to lamp-black and plumbago. It is only since the Hughes microphone was brought out that hard carbon has been used in transmitters with such success. Prof. Hughes has also enabled us to see that Reis's instrument was in reality a metal microphone, and led the way to the production of metal microphones which act as transmitters. These instruments might be regarded as improved forms of the Reis microphone. So may Edison's, since they are all "tension regulators" in a closed circuit. Moreover, they have this advantage, that they have no tympan like the Reis instrument, and are in this respect more distinct from it than Edison's instrument.

The disuse of a "tympan" also comes from Prof. Hughes's discovery, since he found that a tympan was unnecessary.

The question as to what constitutes a "tympan" has been much debated in this country, and some eminent authorities have held that anything constitutes a "tympan." Some are believed to have said that the earth itself constitutes a "tympan." For example, if you lay a microphone on the ground, the latter becomes a tympan. Did Edison, then, intend to patent the earth? Surely not. But even if he did he could not. The supposition is absurd, but it serves to show the fallacy of the view. What these authorities meant was that the earth would act as a physical vibrator. But here we discern how the fallacy arose, for a vibrator in the physical sense is not necessarily a "tympan" in the technical sense, any more than a block of wood is a table, or a bundle of straw is a folding bedstead. By a "tympan or diaphragm," Edison meant a tympan or diaphragm in the usual sense, and nothing else. Had Prof. Hughes not shown that these well-known devices were not necessary to the working of the microphone, we should never have heard that a tympan was anything else

but what it is generally understood to be; and it would not have been necessary to strain the meaning of the word so as to make it include such diverse objects as a block of wood, a quantity of water, or of any vibratory body.

Indeed, if any vibratory body is to be considered as a tympan, we cannot exclude the material parts of the microphone. Hence the Edison claim may be interpreted as the combination of a tension regulator with itself—a conclusion which is absurd.—J. MUNRO, in *La Lumière Electrique*.

UNITED STATES CIRCUIT COURT,

DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY, et al. vs. THE OVERLAND TELEPHONE COMPANY, THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, et al.	In Equity.

UNITED STATES CIRCUIT COURT,

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THE AMERICAN BELL TELEPHONE COMPANY, et al. vs. THE OVERLAND TELEPHONE COMPANY, THE PENN OVERLAND TELEPHONE COMPANY, et al.	In Equity.

UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

THE AMERICAN BELL TELEPHONE COMPANY, et al, vs. THE OVERLAND TELEPHONE COMPANY, et al.	In Equity.

Continental Hotel, Philadelphia, Penna., room 103, Feb. 2, 1885. 12 o'clock noon.

Fred. M. Ott having been appointed special examiner in the above stated cases by stipulation of counsel, the examination of witnesses on behalf of respondents is resumed before him at the above stated time and place.

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the width of the building, could be heard through the instrument, though with some effort. Finally he was told to count, and while counting, Sir William Thomson said: "I will go and talk." The instrument used for a transmitter was made, I think, of tin, was conical in shape, over the larger end of which was tied a membrane to the center of which was fastened an armature of soft iron. In front of this armature was placed an electro-magnet. The words to be transmitted were spoken into the smaller end of the cone. The receiver employed was for a part of the time a second instrument like the transmitter; but another form of instrument proving more satisfactory, at least to some of us, was generally employed. It consisted of a coil of wire surrounded by an iron tube or shell and inclosing an iron core slightly shorter than the other tube. Upon the top of this outer tube rested a plate of thin iron. This receiver I was holding to my ear when Sir William Thomson went to the transmitting end of the line. I heard the last few counts by the assistant; then after a pause I heard the well-known accents of Sir William Thomson's voice and said: "Sir William is now speaking." A moment later I heard him say: "Aye, there's the rub." And repeated the words to the company. I then passed the receiver to the Emperor. He placed it to his ear with an expression of doubt upon his countenance; but immediately this expression changed and he repeated slowly the words: "To be or not to be." The receiver was then passed to others of the party, while those of us who had heard it went over to the transmitting end to examine the apparatus there. On the way, Mr. Gray described to me the construction of the apparatus which he had contrived for transmitting articulate speech electrically, and for which he had filed a *caveat* in the patent office the previous February; illustrating his description by a drawing showing the principle of the water-transmitter. He said he was surprised that the result we had heard had been obtained with the form of transmitter Mr. Bell had used, and remarked that the effect might have been produced by mechanical transmission, although from the arrangement of the

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wires it was not easy to see how this was possible. At the close of the experiments, Sir William Thomson expressed to me his regret that Lady Thomson had not been able to be present, the day being excessively warm, and asked if I could not arrange with Mr. Bell to have the experiments repeated on the following evening, when Lady Thomson would be present. Mr. Bell cheerfully acceded to the request, although he was himself unable to be present. The experiments were made on Monday evening in the Judge's Pavillion, the wires being carried from the private room of the special jury on instruments of precision, into the main hall, to a table near the entrance. Sir William and Lady Thomson were at the receiving end; Professor Watson and myself were at the transmitting end. It was found that the words spoken could be heard through the walls of the building; the transmitter was therefore taken outside of the building, the wires being carried through the window. Most of the transmitting was done by Professor Watson, his voice being louder and more readily transmitted than mine, apparently. Short sentences were read from the New York Tribune, such as "S. S. Cox has arrived," "The American residents in London have decided to celebrate the 4th of July," etc., Sir William Thomson coming with his note book to the transmitting end to compare what he had heard with the sentence as originally uttered.

Q. 6. During this second test, that of Monday, what transmitter and receiver were used?

A. My recollection is that the same instruments were used which were used in the exhibition on the previous day.

Q. 7. You spoke of two receivers being used on the previous day; were both used on Monday evening?

A. I saw both instruments at the receiving end of the line. I was, myself, most of the time, at the transmitting end. The only time that I received, I used the receiver which was the same as the transmitter.

Q. 8. You also spoke of Professor Watson's operating the transmitter, because his voice was louder than yours;

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how loudly was it found necessary to speak in order to be heard and understood over the line?

A. So loud that it was difficult to prevent the sound from reaching the receiving end directly through the air; I remember that a policeman came over from the main building to find out what was the matter.

Recess until 3 P. M.

Q. 9. From your statement of the Sunday exhibition, I infer that there was more or less talking into the transmitter which was not understood at the receiver, or perhaps not heard at the receiver; will you please inform us whether or not such was the fact, and if it was, please inform us as fully as possible, according to your best recollection, to what extent or in what proportion the sound made into the transmitter was audible and distinguishable at the receiver?

A. My recollection is, that, although Mr. Bell's assistant made various attempts to carry on a conversation, nothing whatever was understood distinctly at the receiving end; the transmission was only in one direction, and Mr. Bell sent word to his assistant to count, by a messenger; it was on account of the imperfection of the result that Sir William Thomson, with a trifle of impatience in his manner, the day being intensely warm and the hour for lunch having passed, said, "I will go and talk"; the words I heard from him are, so far as I can recollect, the first constituting a connected sentence which were received upon that day at that end of the line.

Q. 10. In your fifth answer you state that you heard the last few counts by the assistant after Sir William Thomson went to the transmitting end, and then, after a pause, heard the well-known accents of Sir William; how do you wish to be understood with regard to hearing the last few counts by the assistant?

A. I mean simply to say that I heard a succession of counts as distinct sounds; the articulation did not enable me to distinguish what the counts were in numbers.

Q. 11. You have in the same answer quoted two phrases,

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viz.: "Aye, there's the rub," and "To be or not to be," which were heard over the telephone line that day; have you any recollection whether any other sentence or phrase was heard over the line that day or not?

A. My recollection is that nothing connected was heard over the line but those sentences, up to the time when the party broke up to go to the transmitting end, as before stated; after that I was not at the receiving end.

Q. 12. After you went to the transmitting end, was any further effort made to talk through the line that day?

A. The use of the telephone then became general, and several persons tried the instruments; I remember that Professor Hilgard talked while Professor Draper listened, the latter recognizing the accent of the former distinctly, as he afterwards told me; he did not say to me what the words transmitted were.

Q. 13. Did he state to you whether he heard and understood any words?

A. I do not recollect that he did.

Q. 14. How long a time elapsed on that Sunday, from the period when Mr. Bell introduced the subject of his telephone, to the end of the session or exhibition?

A. As I remember it now, for from a half to three-quarters of an hour.

Q. 15. How long a time was occupied in the attempt to operate the telephone instruments that day?

A. From the time the subject of the articulate telephone was introduced, until the time the talking became general, I should say was from fifteen to twenty minutes.

Q. 16. How long a time was occupied on Monday evening in the tests with the telephone?

A. From an hour to an hour and a half, I think; the appointment was made for eight o'clock, and Sir William and Lady Thompson left shortly after nine to attend a reception.

Q. 17. From your tests and observation of those telephone instruments that were used at the Centennial, would you say that they were, or were not, in your opinion adapt-

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ed, without change or improvement, to practical use for business purposes?

A. I was greatly astonished and delighted to hear for the first time the transmission of articulare speech electrically; but I recognized, as did others, that the instruments embodied the germ of the invention only, and must be improved in loudness and distinctness of articulation in order to become a success, commercially.

Q. 18. You have in your fifth answer referred to the fact that during the exhibition of Sunday Mr. Elisha Gray described and illustrated to you his own liquid transmitter telephone, while you were on your way with him from the receiving to the transmitting end of the line; Mr. Bell has stated, I think, that he himself had a liquid transmitter at the Centennial Exposition with his other instruments. What is your recollection, if you have any, with regard to that?

Preamble of the question objected to as an improper statement of an incompetent alleged conversation.

A. I have no recollection that any such instrument was exhibited upon that occasion by Mr. Bell. Had it been upon the table, and certainly had it been taken from the table and exhibited, it must have attracted my attention, as I sat at the table during the whole of his exposition. Moreover, the fact that Mr. Gray made a drawing of his water transmitter, instead of referring to essentially the same instrument, which Mr. Bell claims to have exhibited, proves clearly, in my opinion, that he did not see it either.

All references to Mr. Gray objected to as hearsay and secondary evidence.

Q. 19. Was Mr. Gray present while Mr. Bell was explaining his invention at the table? If so, how far was he from Mr. Bell during that time?

Same objection.

A. Mr. Gray was present during the whole of Mr. Bell's exposition. He stood upon the stairs and looked down upon the table upon which the instruments were placed, being not more than three or four feet distant from them.

Q. 20. Did Professor Bell, in explaining his invention and its mode of operation, mention the subject of a liquid transmitter?

A. He did not, so far as I can recollect.

Q. 21. I have understood that Professor Bell, either at that time or shortly after, left a pair of his telephone instruments in your hands; is such the fact or not?

Objected to as leading and incompetent.

A. It is a mistake; he did not.

Q. 22. When Professor Bell explained his multiple or harmonic telegraph to the company present that Sunday, was the invention a new one to you, or had you known of a similar invention or inventions, before?

Objected to as ambiguous and immaterial, and as leading.

A. It was not new to me; I had read of a similar invention of LaCour, of Copenhagen, and had both seen and experimented with Mr. Gray's harmonic telegraph apparatus nearly or quite two years before, as I believe.

Q. 23. Do you remember how long prior to June 25th, 1876, you had read of LaCour's multiple telegraph?

Same objection, and as calling for secondary evidence.

A. I do not exactly; but it was before I saw the Gray apparatus, because I remember asking him how his system differed from that of LaCour, at the time he first showed it to me. I think Mr. Edison was at work upon a system of synchronous transmission by means of tuning forks before 1876, and that he showed his apparatus to me before that time—before the Centennial.

Q. 24. Did you, at any time in 1876 have any conversation with Mr. Elisha Gray in regard to the commercial value or business importance of the electric speaking telephone?

Same objection.

A. I have had such conversation with Mr. Gray, and at different times; but I am not able to say that any such conversation took place as far back as 1876.

Q. 25. Did any such conversation between you and him take place prior to the establishment of the commercial success of the electric speaking telephone?

Same objection.

A. I hardly know how far back to put the date of the commercial success of the electric speaking telephone; I think the matter referred to between Mr. Gray and myself was early in 1877, although it may have been in the fall of 1876.

Q. 26. What opinion, if any, did Mr. Gray express to you as to the commercial or pecuniary value of the electric speaking telephone?

Same objection.

A. I do not now remember his exact words, of course; but the impression left upon my mind by the conversation was, that he had considered the multiple harmonic telegraph a more valuable invention than the electric speaking telephone, and hence had devoted his energies to the development of that in preference to the telephone.

Q. 27. When the electric speaking telephone first became known to you, did you appreciate the commercial value of the invention, or regard it as more impressive from a scientific than a business standpoint?

Objected to as leading and immaterial.

A. My chief interest in it, very naturally, was a scientific one, but it did not seem to me, at that time, that the electric speaking telephone would become as important commercially as it has proved itself to be.

Q. 28. You are acquainted, I suppose, with the construction and mode of operation of the phonograph, are you not?

Objected to as immaterial.

A. I am.

Q. 29. Is the phonograph an electrical instrument?

A. It is not generally so regarded.

Q. 30. I suppose you also understand the construction and mode of operation of the phonautograph, do you not?

Same objection.

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A. I do; I have that instrument, as well as the phonograph, in my collection at the university.

Q. 31. Is that an electrical instrument?

A. It is not.

Q. 32. Neither the phonograph nor the phonautograph employ electricity in its operation, does it?

A. I have never heard that electricity was used with either instrument.

Q. 33. Have you recently been called upon to make some tests of telephone instruments said to have been invented by Daniel Drawbaugh, of Eberly's Mills, Cumberland county, Pennsylvania?

A. I have.

Q. 34. When and where did you first test such instruments?

A. The first experiments which I made with them were made on the 9th of January, I believe, of the present year, at the Washington hotel, in this city.

Q. 35. Who was present on that occasion?

A. Judge Hill, of counsel, Mr. Daniel Drawbaugh, Mr. George W. Heiges, of Eberly's Mills, and Mr. F. W. Smith, of Boston.

Q. 36. Describe how the lines were arranged and equipped on which that test was made?

A. There were three lines, constituting a complete metallic circuit, extending from room 29 to another room, I think No. 28, across an intervening space of fifteen feet more or less outdoors, the wires passing out from the windows of both rooms; from either room what was going on near the window in the other could be seen; only two of these lines were used in the experiments; on one of these there was a Tisdel telephone at each end; this line being used as a tell-tale line; on the second line, at the end in room 29, was a Drawbaugh instrument of the form known as "C", and at the other end was a second Drawbaugh instrument of the form known as "B".

Mr. Hill states that the instruments used in said tests were reproductions, and were not any of the

identical instruments heretofore put in evidence in these cases or in the suit between the Bell Telephone Company and the Peoples' Telephone Company in New York; these reproductions will in due time be put in evidence in this case.

Recess until 8 P. M.

(Deposition of Professor Barker suspended to take deposition of Alonzo F. McGaffick.)

Feb. 3rd, 1885, 12.30 P. M.

Examination of Professor Barker resumed.

Q. 37. Do you remember whether or not, at that first test, there was a battery in the line, on which the instruments of the form known as "B" and "C" were arranged?

A. I do not know positively, but supposed at the time that there was not.

Q. 38. In the tests that day with those two instruments on the line, who operated at the transmitter, and who at the receiver?

A. Judge Hill operated at the transmitter, and I at the receiver, for the greater part of the time.

Q. 39. Which of the two instruments was used as the transmitter, and which as the receiver, in that test?

A. Instrument of the form known as "C" was used as the transmitter, and instrument of the form known as "B" was used as the receiver.

Q. 40. State the result of the test that day with those two instruments in line?

A. I had no difficulty in hearing distinctly the words and sentences which were transmitted, although the sound was not loud and the resonance in the instrument required some words to be repeated whenever there was any noise in the room.

Q. 41. Do you remember whether or not there was considerable noise in the receiving room, coming from some kind of machinery operating somewhere under the room or near it?

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A. I remember the noise, and the accompanying vibrations, very distinctly; and that is particularly what I referred to in my previous answer.

Q. 42. To what extent were these two instruments tested that day on the line?

A. The experiments with them occupied an hour or two, and continued until I was satisfied of the entire capability of the instruments to transmit and reproduce articulate speech.

Q. 43. Do you recollect whether any other instruments were tested that day by you at the Washington hotel?

A. My recollection is, that instruments of the form known as "I" and "A" were also used upon the line, as receivers.

Q. 44. And with what results?

A. Instrument "I" received louder than "B", but the resonance was very considerable. Instrument "A", though not so loud, gave better articulation. I had no difficulty in hearing all, or nearly all, that was said upon the transmitter when either of these instruments was used as the receiver.

Q. 45. Do you remember whether or not conversations were carried on over the test line and tell-tale line, while tests were being made that day; one line being used to transmit in one direction and the other line being used to transmit in the other direction.

A. Yes; for that was the usual method of experimenting. The tell-tale line was operated most of the time by Mr. Heiges and Mr. Smith; what I heard on the receiver was repeated back over the tell-tale line and verified at the transmitting end of the main line. Conversation was carried on in this way on quite a variety of subjects.

Q. 46. Do you recollect whether you caused Mr. Smith to ask any questions over the tell-tale line, which were answered back to you over the test line?

A. I do not recollect any specific questions of that character; but I remember that questions were asked, and answers thereto transmitted satisfactorily in both directions, over the two lines.

Q. 47. Do you recollect whether Mr. Daniel Drawbaugh

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did any of the talking into the test line transmitter that day, while you were listening at the receiver?

A. I do not recollect positively; but my impression is that he did.

Q. 48. At the conclusion of the test that day, were any of the instruments placed in your charge?

A. Instruments of the forms known as "A", "B", "C" and "I" were placed in my hands for such experiments as I chose to make upon them.

Q. 49. To what place did you take those instruments that were so placed in your hands?

A. They were sent first to my house, and afterwards to my laboratory at the university.

Q. 50. How long did they remain in your possession and control?

A. Until yesterday, when they were delivered by me to the counsel in the case.

Q. 51. Did you make any further tests or experiments with these four instruments at your laboratory at the university, while they were there in your possession?

A. I did make such tests with these instruments at various times and under varying conditions, during the time that they remained in my possession.

Q. 52. Who was present at those tests made by you at your laboratory, and who assisted you in making said tests?

A. Generally my professional assistant was present and assisted me, and sometimes one or more of my students; on two occasions Mr. Drawbaugh, Mr. Heiges and Mr. Smith were present, the two former assisting in the adjustments, and the latter assisting in the tell-tale line.

Q. 53. On how many different occasions did you test those four instruments while they were in your possession at the university?

A. I cannot say exactly; I experimented on several occasions, at the outset, in order to become familiar with the instruments, and to discover the conditions of adjustment which would give the best effect; after that, I made several

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specific experiments to determine the availability of the instruments, as adjusted by myself and by Mr. Drawbaugh.

Q. 54. Please describe the conditions under which the tests at the university were made—the arrangement and distance of the rooms and so forth?

A. Two lines were employed, one of which was a tell-tale line and the other a test line, precisely as in the experiments already described. These lines extended from the table in my lecture room to a little private room on the next floor below and to the east of the lecture room, known as the experiment room, the distance being from a hundred to a hundred and fifty feet, on the line followed by the wires. On the right hand or tell-tale line was a pair of Tisdel telephones; on the left hand or test line the instruments to be tested were placed. The form known as "I" was used generally in the experiment room, and the form known as "C" in the lecture room. Instruments "A" and "B" were sometimes used in the experiment room in place of "I".

Q. 55. Did anybody control in any way or suggest the selection of the assistants whom you have mentioned—I mean your regular professional assistant, or your students—or did you select them without suggestion?

A. The condition under which I consented to test the instruments referred to was, that they should be put into my hands absolutely, without conditions as to the tests which should be made with them, the manner of making those tests and the assistants I should employ in conducting them. The whole matter was entirely under my own control, and all the arrangements were made by myself, no suggestions being offered by any one, and no assistance rendered unless at my request.

Recess until 3:15 P. M.

Q. 56. What results did you obtain from the tests which you made at the university with those four instruments during the time that you had them in your sole charge?

A. The results which I obtained with these instruments were in general entirely satisfactory. Using the forms known as "I" and "C" in the same circuit, conversation

could be very readily carried on, whichever one was used as the transmitter. When "B" or "A" was used as the receiver, "I" or "C" being used as the transmitter, the results were less satisfactory, because less loud; and it was necessary to repeat some of the transmitted words. When, however, a battery current was employed upon the test line with these receivers, they became louder and gave equally satisfactory results.

Q. 57. You have told us about one day's test of these four different kinds of instruments, at the Washington hotel, in this city; did you on any subsequent day make any tests with any other Drawbaugh instruments at the Washinton hotel? If so, about how long was it after the first day's test, to which you have referred, and what form of Drawbaugh instruments did you test on this second occasion?

A. I did make a second series of experiments at the Washington hotel about ten days after the experiments already referred to. The same lines which have been already described as used in the first set of experiments were used in the second. At the transmitting end of the line, in room 29, were two instruments of the form known as "F", or tumbler transmitter, one of these having a single rod to support the wooden cup, and the other having two such supports. Two Laclanche cells were used in circuit with the tumbler transmitter. At the receiving end an instrument of the form known as "B" was used almost exclusively.

Q. 58. To what extent did you test these instruments at the Washington hotel on that occasion, and in what manner?

A. The entire afternoon was spent in experiments with them, Judge Hill being, for the greater part of the time, at the transmitting end, engaged in conversation with me at the receiving end. The sound given by the receiver was very loud, and could be heard several feet distant. When properly adjusted the transmitter gave excellent results, the articulation as heard in the receiver being distinct and clear. It was interfered with, however, slightly by the effect of

resonance. After considerable miscellaneous conversation various commercial transactions were conducted through the instrument, such, for example, as related to the purchase and delivery of coal, the purchase of railroad and parlor-car-seat tickets, and the like. Paragraphs were also read to me out of the newspaper. Both transmitters were used at different times, and Mr. Drawbaugh and Mr. Heiges talked to me through these instruments.

Q. 59. You use the expression, "After considerable miscellaneous conversation"; what kind of conversation, and how conducted, do you refer to?

A. In these experiments, as in the former ones, conversation was carried on by means of both lines, the question being asked, for example, over the test line, and the answer returned over the tell-tale line, or vice versa. The conversation, as I remember it, referred to the construction and operation of the instruments employed, to the suits in which the testimony was to be given, to the state of the weather, present, past and to come; to various geographical statements, such as "Harrisburg is the capital of Pennsylvania, and is situated on the east bank of the Susquehanna river," etc.

Q. 60. Were any of these instruments of the form known as "F" placed in your hands at the close of that test, for the purpose of enabling you to further test and experiment with them, at such place, under such conditions and with such assistance as you might see fit to select?

A. Both of the instruments referred to of the "F" form, were placed in my hands without conditions, for the purposes stated.

Q. 61. And did they, also, remain in your hands until yesterday?

A. They did.

Q. 62. Did you, subsequently to the tests at the Washington hotel, proceed to further test those instruments of the form known as "F", and to experiment with them; if so, where, when, to what extent, under what conditions, and with what assistance?

A. I did so experiment with these instruments. I marked the instruments with the double supporting arm "F 1", and the one with the single supporting arm "F 2". On the same evening in which they were received, the glass tumbler of "F 2" was crushed by the contraction of the wooden cover, and the tumbler of "F 1" was substituted in its place. A day or two afterward, Mr. Drawbaugh placed in my hands another similiar transmitter with a double support, Mr. Smith subsequently taking away the top portion of "F 1". I marked the new transmitter "F 3". One set of experiments was made with transmitter "F 1", before it was taken away; the other experiments were made with "F 2" and "F 3" as transmitters. The experiments were made at the University of Pennsylvania, on the same lines and between the same rooms, in essentially the same way as the experiments which have already been detailed, which were made with the other Drawbaugh instruments. Indeed, in all the tests which have been made since the receipt of these instruments, they have been tested by means of, and simultaneously with, the other instruments mentioned. I also obtained from the Washington hotel a second instrument of the form known as "B", which I marked "B 2"; the one above mentioned having been marked "B 1". Subsequently Mr. Drawbaugh brought to the university two other instruments known as "I" and "C", which were marked by me "I 2" and "C 2", respectively. In the tests which were made at the university after this time, these instruments were all used, either at one time or another. The same gentlemen assisted me in the tests, in the main; and the experiments were conducted by me solely with a view to satisfy myself of the capabilities of the instruments.

Q. 63. If I understand you correctly, when the glass portion of the instrument "F 2" broke, the instrument "F 1" was taken apart and its glass portion was substituted in place of the broken glass of instrument "F 2", while its top and operative parts, deprived of their glass support, were not afterwards used by you, but were delivered by you to Mr. Smith and by him taken away; so that, of the

two remaining tumbler instruments, the one marked "F 2" was the one with the single rod supporting the carbon holding box, and the one marked "F 3" was the one with a double rod or yoke, supporting the carbon holder; am I right?

A. I believe that is entirely correct.

Q. 64. From your various tests at the university, with those instruments of the "F" form, what results did you get?

A. The results obtained with both the "F" transmitters, when in good adjustment, were in every way satisfactory; on the last occasion when tests were made with them, receivers "B 1", "B 2", "I 1", "I 2", and "A" were employed; on that occasion Judge Hill was good enough to assist at one end of the test line; with "F 2" as a transmitter, two Laclanche cells being in the circuit, and "B 1" being used as a receiver, it was easy to hear throughout the room that words were being transmitted; but it was necessary to be within a few inches of the receiving instrument, in order to understand these words; essentially the same results were obtained with "F 3" as a transmitter, and with "I 1" and "A" as receiver, on that occasion; the articulation, when "A" was used as a receiver, was so good and so free from resonance as to be, in my judgment, quite equal to the average results from other similar instruments which I have heard, such as the Phelps, the Blake, the Short, the Clay or the Baxter carbon transmitters; to test this question still further, I asked the college carpenter, whose familiarity with telephones is very slight, to listen upon "A" while Judge Hill or myself talked to him upon one or the other of the "F" transmitters; my assistant repeated over the tell-tale line what was heard at the receiving end, and it was verified; when well adjusted, everything spoken into the transmitter seemed to have been correctly received, and was correctly reported back; one sentence, I remember, was, "Harrisburg is the capital of Pennsylvania, and is situated in Dauphin county."

Q. 65. In using the two forms of Drawbaugh tumbler

instruments, to wit, the one form with a single stem or rod supporting the carbon holder, and the other form with the double rod or yoke supporting the carbon holder, did you observe any difference in the operation of the instruments; and, if so, which of the two forms operated the most satisfactorily?

A. If there was any difference in the results obtained with the two transmitters mentioned, the advantage seemed to lie with the one having the single stem.

Recess until 8 P. M.

Feb. 4th, 1885, 10 A. M.

Examination of Professor Barker resumed.

Present: Same counsel.

Q. 66. You have several times referred to the resonance of the instruments; please explain more particularly what you mean by that, and to what cause you attribute any undue resonance in the telephone instruments?

A. The word "resonance," as I understand it, is used to express a sympathetic vibration of any material in contact with a sounding body. This substance may be air, as in the Helmholtz resonator, or it may be a solid substance, as in the sounding board of a piano, for example. In the case of an air cavity, when the air column is tuned in unison with the vibrating body, as in the resonant case of a tuning-fork, the resonance powerfully reinforces the sound of the vibrating body; but when the air in the cavity is not so tuned, other vibrations are produced which render the vibrations of the sounding body itself less distinct. In the earlier forms of telephone receiver, there was a considerable air cavity in front of the diaphragm, the resonance in which interfered with the distinctness of the articulation. This cavity was generally conical in shape, with its base towards the diaphragm. On reversing the form of the mouth-piece, so that the smaller end of the cone was towards the diaphragm, and on diminishing the air space in front of the diaphragm to a minimum, as in the later forms of receiving telephone, the resonance has been nearly or quite destroyed.

Q. 67. In the case of The American Bell Telephone Company and others against The People's Telephone Company and others, in the New York Circuit, the evidence in which has been stipulated into these cases, one of the witnesses (George H. Bowman) testified, in substance, that a certain time, at Drawbaugh's shop, he was present at the receiving end of Drawbaugh's talking-machine line when some persons were operating the machines; that the receiving operator had the instrument at his ear, and he (the witness) standing with his head perhaps eighteen inches away from the instrument, heard the sounds proceeding from the instrument, so as to distinguish that talking was coming through it, although he did not hear with sufficient distinctness to understand what it was saying. Had you, in your tests at the Washington house or at the university, any similar experiences with the Drawbaugh instruments; and, if so, will you state your own experiences in that particular?

A. In the second set of experiments at the Washington house, which were made on Tuesday, the first set having been made on the preceding Friday, the transmitter used was of the form known as "F". During the adjustment Mr. Smith was at the receiving end and was listening upon a receiver of the form known as "B". Judge Hill was talking into the transmitter. When adjusted he requested Mr. Smith to pass the receiver to Professor Barker. This request I heard distinctly though I was nearly or quite two feet away from the receiving instrument. Subsequently, at my house, I tested a receiver of the form known as "C", upon a line between my house and that of a friend, he using a Clay carbon transmitter with a battery. The sounds were heard distinctly all over the room, and the words could be recognized generally at a distance of two feet or more. In the experiments at the university, the sounds produced at the receiving end of the line, whenever the form of transmitter known as "F" was used at the other, and in good adjustment, could be recognized all over the room as spoken words, whether receivers of the form known as "B" or "I" were employed, and upon one or two occa-

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sions when I had the receiver, my assistant recognized the words spoken, sitting nearly or quite two feet away.

Q. 68. When you stated in your last answer that you distinctly heard the request made through the test line to Mr. Smith, to hand the receiver to Professor Barker, did you mean that you heard and understood the request while you were at the distance stated from the receiver, or that you merely heard from the receiver the sound of talking without being able to distinguish the words?

A. I mean to say that I heard and recognized the words distinctly, so that when Mr. Smith passed me the receiver, saying to me, "Judge Hill desires to have you take this", or words to that effect, I replied, "It is not necessary for you to repeat it", as I myself heard what he said distinctly.

Deposition of Professor Barker suspended at this point.

March 13, 1885, 4 P. M.

Examination resumed at Colonnade Hotel, Philadelphia, Penna., room 19.

Present: Mr. Dickerson for complainant.
Mr. Hill for respondents.

Examination of Professor George F. Barker resumed.

Examined by Mr. Hill:

Q. 69. Your deposition, Professor, was suspended on the fourth day of February, 1885, for the purpose of enabling respondent's counsel to make tests of the reproduced Drawbaugh instruments in the presence of complainant's counsel and experts, at such time as might be found convenient for both parties. Will you now inform the court whether or not you did make such tests in the presence of complainant's counsel and experts?

A. The tests referred to were made and in the presence of counsel and experts on both sides of this case.

Q. 70. When and where were those tests made?

A. They were made at the Washington hotel in this

city on the afternoon of Friday, February 6th, between rooms 28 and 29.

Q. 71. Do you remember how long the tests were continued that afternoon?

A. I did not note the time exactly; my impression is, that they continued about three hours.

Q. 72. Except as to the parties present, how did the conditions under which the tests of February 6th were made compare with the conditions under which your prior tests of the Drawbaugh instruments had been made, at the Washington hotel, as you have already testified?

A. The conditions under which the tests were made on February 6th were, I believe, in all essential respects the same as those observed during the two previous tests already described. The main line connecting the two rooms was used in connection with the tell-tale line, both being metallic circuits, and the method of experimentation followed was in general the same upon all the occasions referred to; the conversation coming over the main line being repeated back over the tell-tale line and verified at the transmitting end.

Q. 73. There were stenographers present on the part of both the complainants and the respondents, in the two rooms in which the tests were made; were there not?

A. There were.

Respondents' counsel states that during the tests of February 6th the complainants had a stenographic report made of all that took place in the rooms at the two ends of the test line; and the respondents also had a stenographic report made of the proceedings in each of said rooms; each party having its own stenographic reporters present. By consent of both parties the reports of the two stenographers who were present at the tests on behalf of respondents are offered in evidence to be marked respectively "Exhibit Respondents' Stenographic Report, Room 28", and "Exhibit Respondents' Stenographic Report, Room 29",—to have the same effect as if the

stenographers had been called as witnesses to verify the said reports, and had verified them as the reports made by them respectively at the time; it being understood that the reports made by complainants' stenographers may be admitted in the same manner, if desired by complainants' counsel to supplement any statements which may appear to be omitted in these reports.

Q. 74. Will you please give the court a detailed statement of the tests made at the Washington hotel, February 6th, 1885, referring, if you wish to refresh your memory, to the stenographers' reports that have just been put in evidence, and to any memoranda which you may have made at the time, to assist your memory?

A. The first experiments, which were made in the afternoon of February 6th, were made with an instrument of the "F" form as transmitter, and an instrument of the "B" form as receiver, two Leclanche cells being in circuit. The transmitter was adjusted by Mr. Drawbaugh, I myself being at the receiver. After the adjustment was made, conversation was carried on and several sentences repeated over the test line. These were reported back over the tell-tale line for verification. The transmitter was then passed to Judge Hill, and conversation was very readily carried on by means of the two lines just referred to. An article from the *Press* of that morning, relating to the reception of Mr. Hendricks at Atlanta, was also transmitted to me. I was able to understand with perfect distinctness all that was said at the transmitting end, after the adjustment had been completed, excepting, perhaps, an occasional word, both when Mr. Drawbaugh and Judge Hill were talking. The receiver of the form "B" was then removed and a receiver of the form "I" substituted for it. My recollection is, that this receiver was a little louder than the other, the articulation being quite as distinct. Up to this point the transmitter used had been the one-legged form of the tumbler instrument; the two-legged form of the same instrument was now substituted for the other, a receiver of the

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"I" form being used with it. Conversation was carried on with these instruments satisfactorily, and another newspaper article was transmitted and received without difficulty.

Adjourned until Saturday, March 14, 1885, at 10 A. M.

March 14, 1885, 10 A. M.

Examination resumed.

Present: Same counsel.

(Witness continues): The newspaper article read in the second experiment was taken from the *Philadelphia Press* of that morning, copied from the *New York Independent*, and entitled, "Hearty Endorsement of General Logan." In the third experiment, another instrument of the "F" form was employed, as above stated, but in which the carbon box was supported by two legs instead of one. When this instrument was put on the line, it did not require any additional adjustment, conversation being transmitted to me by Judge Hill without any difficulty. Judge Hill then adjusted it himself slightly, which diminished the loudness but improved the articulation. The newspaper article which was then read was also taken from the *Press* of that morning, and consisted of a dispatch from Washington in reference to Democratic absentees from the House and Senate, who had gone to New York to interview Mr. Cleveland. During this article, which was quite long, the transmitter was adjusted once by Judge Hill. In the fourth experiment the two-legged transmitter of the "F" form was used, and an instrument of the "B" form as a receiver. Conversation was carried on with these instruments without difficulty; various sentences were transmitted and received correctly, and an irregular series of numbers was counted, and, in general, correctly received. In the fifth experiment an instrument of the "C" form was used as a transmitter, "B 2" being still used as the receiver, and a battery being in line. Judge Hill conversed with me through these instruments, referring among other things to the illness of General Grant and to Mr. Ott's toothache. In

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the sixth experiment, the same instrument was used as transmitter, but the battery was removed from the line, the receiver used being the "I" form. After a few sentences, Judge Hill passed the transmitter to Mr. Drawbaugh, whose voice I at once recognized. He changed the adjustment of the instrument slightly, and then carried on the conversation through the line and counted some irregular numbers; he then placed on the line another instrument of the "C" form, and in the seventh experiment I received from him distinctly a variety of sentences. Judge Hill then took the transmitter and talked to me about various matters, particularly about the explosion in room 28, and about the cabinet appointments of Mr. Cleveland. In the eighth experiment the same transmitter "C" was used in room 29, and "B 2" was used in room 28 as receiver. Miscellaneous conversation was then carried on, on the two lines, between Judge Hill and myself. In experiments one, two, three and four, in which the transmitter was of the "F" form, the results, in my judgment, were in general entirely satisfactory, with the receiver of the "B" form as well as with the receiver of the "I" form. In experiments five, six, seven and eight, the articulation was very good, but the sounds were much less loud, and, therefore, more liable to be interfered with by extraneous noises.

Q. 75. In repeating back through the tell-tale line from the room in which you were stationed at the test-line receivers, to the room in which Mr. Drawbaugh and Judge Hill were operating the test-line transmitters, was there any failure, at any time, to get the words perfectly through the tell-tale line?

A. There seemed to be such difficulty at various times; I had to correct what was spoken into the tell-tale line at my end several times, deeming it necessary where the errors made were material; the word "polarization," for example, which came perfectly well through the test line seemed to fail of transmission through the tell-tale line, and it was sent to room 29 by a messenger; moreover, in comparing the stenographer's report of what was transmitted on the

tell-tale line with what was received on the same line I observe some errors of transmission.

Q. 76. Are not such errors more or less common to all telephone lines in practical use for business purposes?

A. My own experience is, that they are.

Q. 77. And words and sentences frequently have to be repeated and even spelled out occasionally on almost all telephone lines, do they not?

A. They do.

Q. 78. In your 75th answer you say, you had to correct what was spoken into the tell-tale line at your end several times, deeming it necessary where the errors made were material; explain a little more fully just what you mean by that statement?

A. I mean simply that on attempting to repeat what I had said as received by me upon the test-line, the person transmitting over the tell-tale line would make errors in repeating my words, especially when the sentence was at all long. For example, in the first experiment I said "I hardly know what to say." The person transmitting through the tell-tale line said "I don't know what to say;" and I corrected him, and he then transmitted the sentence correctly.

Q. 79. Referring to the Drawbaugh instruments, which you tested at the Washington hotel and at the University of Pennsylvania in January last, and at the Washington hotel on February 6th, have you compared those instruments with the remains of the original instruments "B", "F", "C", "I", put in evidence as exhibits in the suit of the American Bell Telephone Company and others against the People's Telephone Company and others, in the United States Circuit Court for the Southern District of New York, and with the reproduced instruments of the same form and the drawings and photo-lithographs, all in evidence in the same cause; if yes, please state the result of your comparison as to the substantial identity of the reproductions tested by you this winter, as you have described, and the original machines or instruments of which they

purport to be reproductions; stating whether you know of any practical or material variations from the plan or construction of the original instruments, and giving your opinion to the fairness and conclusiveness of the tests which you have made this winter and have described in your depositions?

A. I have made comparison of the instruments of the forms known as "B", "C", "F" and "I" with which I made the experiments at the Washington hotel and at the University of Pennsylvania, with the remains of the original instruments in the hands of the examiner, and with the photo-lighographed representations of the same. On the 20th of January I called upon Mr. Ott at the Continental hotel in this city, and examined the parts of the said Drawbaugh instruments which were in his possession. I compared the original drawings of these instruments with the instruments themselves, and satisfied myself that these drawings were, in all essential details, accurate representations of the instruments from which they were taken. I also compared the drawings of certain of these forms of instruments which had been reproduced in the original reproductions, and found these also to agree essentially in all their details. Having received from counsel, photo-lithograph copies of these drawings, I compared these with the reproduced instruments of these forms with which I experimented. My opinion is, as the result of these comparisons, that the instruments with which I experimented, of the form specified, are faithful *fac-similes* of the original instruments in all essential details, at least, so far as can be judged from the incomplete originals in the hands of the examiner. It is clearly evident, in my opinion, that the original instruments known as "B", "C" and "I" must have been constructed as, and if used at all, must have been for magneto-telephones. My opinion is, further, that the instrument of the form known as "F" was constructed for the purpose of telephonic transmission on the principle of varying the resistance of the line. Believing that the reproductions of these originals are faith-

ful copies of these, without any practical or material variation in their plan or construction, so far, at least, as can be judged from the portion still in existence; and the tests made with these reproductions having shown that they are fully capable, in my judgment, of transmitting articulate speech, successfully, I am led to the opinion that the originals of these instruments may have been used successfully for a like purpose. That the reproduced instruments have been fairly made, and have been experimented with with entire fairness, so far as my knowledge of them goes, is beyond a question, in my opinion.

Recess until 1.45 P. M.

Q. 80. Will you please describe the material employed in the "F" form of instrument during your several tests—I mean the material contained in the small box suspended inside of the tumbler, and through which the battery current passed?

A. The material which was contained in the wooden box referred to was, in the case of the instruments heretofore designated as "F 1" and "F 2", carbon, more or less finely divided; it looked to me like coke which had been pulverized to a moderate degree of fineness, and in this form placed in the wooden box. In the case of instrument marked "F 3", the carbon contained in the wooden box was much finer and appeared to be mixed with some metallic powder, probably bronze powder.

Q. 81. What, if any, difference of result did you observe in any of your tests, between these instruments of the "F" form having the different carbons, as you have stated?

A. The difference between them was not very decided. When properly adjusted, they all transmitted satisfactorily. My impression is that, of the two-legged transmitters, "F 1" and "F 3", the latter gave a trifle better articulation than the former; "F 2", however, seemed to be rather easier to adjust, and to stay in adjustment better.

Q. 82. How do the results of these tests compare with the results of the tests of Alexander Graham Bell's instruments at the Centennial?

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A. The articulation of the Drawbaugh magneto instruments, in the tests referred to, was fully equal if not superior to anything that I heard upon the instruments of Mr. Bell, while the former were distinctly louder than the latter, as I recall them. The results obtained with the "F" transmitter were decidedly more satisfactory for commercial purposes, with both receivers "B" and "I", than anything obtained with the magneto instrument at the Centennial.

Q. 83. With the Drawbaugh magneto instruments, of the "B", "C" and "I" forms, did you experience any difficulty in keeping them in adjustment when once they were properly adjusted?

A. I did not. Instrument "I" was never adjusted while in my possession, and instruments "B" and "C" were adjusted only once or twice for the purpose of observing the effect of varying the distance between the poles of the magnet and its armature; neither of these instruments got out of adjustment when in use, if properly handled.

Q. 84. How about instruments of the "F" form, so far as adjustment and staying in adjustment are concerned?

A. The instruments of the "F" form, so far as my experience with them goes, are equally adjusted by turning a screw or screws attached to the rod or rods holding the carbon cup; when once in adjustment, if allowed to remain fixed in one position, they retain their adjustment very well; but when disturbed, as when the tumbler is taken in the hand and held to the mouth, the loose carbon in the box may change its position and impair the articulation; in some cases, however, the articulation continues good in spite of such disturbances; and even when injured, the articulation may generally be restored by slightly tapping the instrument.

Cross-examined by Mr. Dickerson:

X-Q. 85. How many days before Sunday, the 25th of June, 1876, was it, when you issued your invitations for the exhibition of that day?

A. I do not remember exactly; my impression is that it

was three or four days; some of them were given verbally, some of them by note, and at different times.

X-Q. 86. At any rate, it was before the Friday evening when Mr. Bell called on you; was it not?

A. My impression is that it was.

X-Q. 87. The principal object of that meeting was the exhibition of Gray's harmonic telegraph; was it not?

A. I myself regard Mr. Gray's harmonic telegraph as the most important thing that was to be exhibited on that day; it was the thing that we were to see on that particular day.

X-Q. 88. When Prof. Bell called upon you on Friday evening, did he explain to you what he wished to have seen by the assembled gentlemen on the following Sunday?

A. My recollection is that he did not, at least specifically.

X-Q. 89. After you had got through with the exhibition which was the object of the meeting, and the party had accepted Mr. Bell's invitation to see his apparatus and had gone where it was, did not Professor Bell explain to you the theory of his invention of the telephone?

A. My recollection is that he did not mention the theory of the telephone, except in so far as it was done in describing the harmonic telegraph; it was already late, and the allotted time very nearly exhausted; it was very warm, and signs of impatience were becoming manifest on the part of some of those present; when the subject of the speaking telephone was reached, therefore, my recollection is, that he confined himself pretty closely to a statement of the facts, without discussing specifically the theory of the instrument.

X-Q. 90. You said that you were "greatly astonished and delighted to hear, for the first time, the transmission of articulate speech electrically"; did not the other scientific gentlemen present express themselves as greatly astonished and delighted also, in consequence of that exhibition?

A. I believe that they did, without exception.

X-Q. 91. And do you think they went away without having communicated to them the theory that this result was produced by causing electrical undulations, similar in

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form to the vibrations of the air accompanying the voice of the speaker?

A. Of course, I cannot speak for the others present; perhaps, very naturally, their interest in the remarkable result that they had just witnessed led them to question Mr. Bell in regard to the theory of the telephone; as for myself, the mode of operation of the instrument was obvious, at once, as soon as it was exhibited; it was one of those marvellously simple inventions that causes one to wonder on seeing it for the first time, that it had not been invented long before; as I have already said, I do not remember that Mr. Bell discussed in my hearing the theory of the instrument; and my recollection is that it was not until some months afterwards that I heard of Mr. Bell's theory of an undulatory current specifically.

X-Q. 92. Wouldn't you say that, among those present, Sir William Thomson would be recognized by the scientists of the world as the most learned and expert electrician of the party?

A. In the general sense, unquestionably.

X-Q. 93. Professor T. Sterry Hunt was present also, was he not?

A. I do not recollect positively; he may have been.

X-Q. 94. In this case a letter from him to Mr. Bell is in evidence, dated the same day, in which he says: "I returned to my hotel with Sir William Thomson and dined with him. He speaks with much enthusiasm of your achievement. What yesterday he would have declared impossible he has to-day seen realized; and he declares it the the most wonderful thing he has seen in America. You speak of it as an embryo invention, but to him it seems already complete, and he declares that before long, friends will whisper their secrets over the electric wire. Your undulating current he declares to be a great and happy conception." Now, does that cotemporaneous document refresh your memory any as to what was talked of and expressed by those present?

The alleged letter and all statements therefrom objected to as secondary evidence.

A. It does not. I have already said that I do not remember hearing of Mr. Bell's undulating or undulatory theory of the telephone until some months after that exhibition. It is quite probable that the theory of the telephone may have been discussed between Sir William Thomson and Mr. Bell in a private conversation on that day.

X-Q. 95. As you recognized that theory when you saw the instrument operated, and as it—the telephone—was a new phenomenon, performing its astonishing results by the use of the undulatory current and by that alone, don't you believe it was recognized by the others as well as yourself, and talked about?

Objected to as assuming that the witness has testified to recognizing any particular theory, when he saw the instrument operated; secondly, because the question assumes a theory; and thirdly, because the question asks the witness for an opinion as to a fact entirely outside of the domain of expert testimony, upon which an opinion is not evidence.

A. When I saw the instrument in operation I recognized that the vibration of the armature attached to the diaphragm in front of the poles of the sensitized magnet, developed a counter electro motive force which varied the current on the line proportionally. Of course, others besides myself may have seen at that time that this was the mode of action of the transmitting instrument. The word "undulatory" did not occur to me, so far as I recollect, in this connection.

X-Q. 96. But don't you know that that word is used to express in short the phenomenon which you have described in more words in your last answer, when applied to the transmission of speech over the telephone?

Objected to as an attempt to examine the witness upon the subject of the theory of the electric speaking telephone, a matter on which he was not examined in chief, and as to which, if the complainants

now examine him, they make him their own witness.

A. I know that the word "undulatory" has been used by Mr. Bell to characterize the currents which are produced by, or result from, the action of the magneto transmitter.

X-Q. 97. When Elisha Gray doubted that the apparatus transmitted speech with the form of transmitter Mr. Bell there used, and suggested "that the effect might have been produced by mechanical transmission", what did you understand to be the method suggested by the words "mechanical transmission"?

A. I do not understand that Mr. Gray "doubted" that the result had been produced with the form of transmitter that Mr. Bell used, because he had himself heard it. My statement was: "He said he was surprised that the result we had heard had been obtained with the form of transmitter Mr. Bell had used." It will be remembered that in the preceding February, Mr. Gray had filed a caveat in the patent office for transmitting speech electrically, the transmitter being an instrument for varying the resistance on the line. This, so far as any evidence in my possession goes, was before Mr. Bell had succeeded in accomplishing this result. Mr. Bell's transmitter operated by varying the electro motive force on the line, and thus differed in principle from Mr. Gray's. I understood Mr. Gray's surprise to arise from the fact that this result could be obtained in this way, and not from the fact that it was obtained at all. In my answer referred to in the question, I used the word "might" in the sense of possibility, and probably "could" would have been the better word. The impression that I received from Mr. Gray's remark was, that on hearing the sounds in the telephone, the first impression was, that they had been transmitted mechanically by an actual vibration of the intervening medium, as in the string telephone, so-called; but that on examining the wires, they appeared to be so fastened that such mechanical transmission did not seem to be possible.

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X-Q. 98. That is, he doubted the electrical transmission of speech by the apparatus there shown, and actually examined the wire connections to ascertain whether it hadn't been transmitted mechanically; and when he found that their arrangement excluded that hypothesis, he accepted the truth with surprise; is not that so?

A. My previous answer contains all that I know upon that subject.

X-Q. 99. Did you mean to say, in any answer you have given, that before the 25th of June, 1876, Elisha Gray had ever made an electrical speaking telephone of any kind, or that then, or at any other time, he ever told you that he had made one before that time?

A. I believe I have not said any such thing.

X-Q. 100. Do you know who made the reproduced Drawbaugh telephones that you experimented with, or who fitted them up for operation?

A. I do not.

X-Q. 101. Do you know who prepared the carbon powders that were used in the different forms of instrument "F"?

A. Mr. Drawbaugh stated to me that he prepared them himself; I know nothing further than this.

X-Q. 102. Do you know who F. W. Smith of Boston is, and what connection he had with these constructions and preparations; or have you had any talk with him on the subject?

A. I suppose he is the Mr. Smith who was present in the early part of the tests of the Drawbaugh telephones, made in January. I have no knowledge that he had anything to do with the construction of these instruments, and I had no conversation with him upon the subject. All the assistance that he ever rendered, to my knowledge, was in listening to the instruments, either on the test-line or on the tell-tale line. I have not seen him since the latter part of January.

X-Q. 103. The argument which you have been called upon to adopt and swear to, supplementary to your state-

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ment of facts, as I understand it, is this, when stated syllogistically:

1. The new reproductions are successful talking telephones, and substantially as good articulators as those in common use.

2. These new reproductions are *fac-similes* of the first reproductions and of the original instruments, in all particulars essential to the transmission of speech.

3. Therefore, the original instruments and the first reproductions were successful talking telephones, and substantially as good articulators as those now in common use; because the laws of nature are constant, and like causes must be followed by like results.

Is not that the argument which you propose to present to the court?

Objected to; first, as assuming that the witness has been called upon to adopt or swear to any argument, whereas, on the contrary, he has only been called upon to examine and state facts which have become known to him through his own investigations; secondly, as assuming apparently that the first reproductions of the Drawbaugh telephones were, when examined by the witness and compared with the instruments in his hands for testing, in such condition as to adjustment or freedom from the effects of wear and tear, as to be ready for use as successful speaking telephones; the question itself being grossly argumentative and cunningly designed to so couple the first reproductions with the last as to make whatever statements the witness may have given or may give concerning said last reproductions and their tests by him, apply to the first reproductions, which he has not tested.

A. The form of statement in my direct answer referred to is as follows: "Believing that the reproductions" (meaning by this the instruments experimented with by myself) "of these originals are faithful copies of these, without any practical or material variation in their plan or construction,

so far, at least, as can be judged from the portions still in existence, and the tests made with these reproductions having shown that they are fully capable, in my judgment, of transmitting articulate speech successfully, I am led to the opinion that the originals of these instruments may have been used successfully for a like purpose." The statement which I have now made, and, in so far as it is synonymous with it, the statement which is made in the question is what I intend to have go before the court.

X-Q. 104. What I want to know particularly is, whether you wish to go before the court with the sworn statement that, as a matter of fact, to your knowledge, either the original instruments or the first reproductions were *facsimiles* of, or substantially identical with, the exhibits put into your hands by somebody for trial, in respect to the conditions or constructions essential for the successful transmission of speech?

A. I wish to go before the court with the exact opinion stated in my last answer; no more, no less.

X-Q. 105. Do you know anything about the truth of the assumption in the argument, that the originals and the first reproductions, or either of them, were, when they were in condition to be operated practically, substantially identical with the instruments you tested, in respect to the construction and the conditions essential for the successful transmission of articulate speech, about which you have expressed an opinion in the form of a belief?

Objected to as mere badgering; the meaning of the witness in the testimony he has given being perfectly clear, and the meaning of the question being very obscure.

A. As I did not see either the originals or the first reproductions of the Drawbaugh instruments in question before the month of January last, I cannot, of course, state what their condition as to construction or adjustment may have been previous to that time; as a result of comparisons made between the reproductions with which I experimented and the originals and first reproductions of the Drawbaugh

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instruments, I came to the conclusion expressed in my answer to direct question 79, as follows: "My opinion is, as the result of these comparisons, that the instruments with which I experimented, of the forms specified, are faithful *fac-similes* of the original instruments in all essential details, at least so far as can be judged from the incomplete originals in the hands of the examiner." The belief stated in the latter part of that answer is based upon the evidence afforded by the examinations and comparisons of the various instruments concerned, as detailed in that answer.

X-Q. 106. You have also sworn that, in your opinion, the man who made the "F" transmitter originally, and the receiver to go with it, did so with the intention of producing a talking telephone; isn't it also your opinion, that that intention must have been founded upon, first, the theory that the electrical undulations must be made to conform substantially to the form of the air waves; and secondly, upon the fact that the substance in the box varied its conductivity under varying pressure so as to produce these undulations?

Objected to as assuming that the electric speaking telephone could not have been invented, except by a person who had distinctly formulated the so-called undulatory theory of transmission; whereas, if the assumed inventor conceived of a plan by which the vibrations of the diaphragm spoken to were simply reproduced or copied electrically by the diaphragm of the receiving instrument, he could have produced the invention as readily without assuming anything about the form of the vibrations, or of the currents passing on the line between the instruments.

A. I fail to find in my testimony any opinion as to the intention of "the man who made the 'F' transmitter originally, and the receiver to go with it." I suppose what is referred to is the following (see Q. 79): "My opinion is, further, that the instrument of the form known as 'F' was constructed for the purpose of telephonic transmission on the principle of varying the resistance of the line." If this

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is the opinion referred to, then it does not seem to me to carry any opinion as to the intention of the inventor with regard to any particular theory of its action, or any opinion that any theory whatever of its action must have been formed by him.

Re-direct by Mr. Hill:

Q. 107. In your cross-examination, you have referred to the instrument known as a string telephone; is it not necessary to the transmission of speech by that instrument, that the connecting string should be drawn taut, or put under tension?

A. It is; the transmission is improved by tightening the cord.

Q. 108. What was the character of the fastenings connected with Professor Bell's telephone at the Centennial that precluded the mechanical transmission of the sounds over the wire?

A. I did not examine them closely, but the transmitting and receiving stations were not in sight, the one from the other, so that the wire could be stretched direct. It went around by a somewhat circuitous route and was fastened at several points to the building. While this did not absolutely preclude mechanical transmission, it rendered it extremely improbable; but until this hypothesis was removed, the fact of electrical transmission remained in doubt.

Q. 109. And from what you saw and heard there, you were left in no doubt as to the fact of electrical transmission, were you?

A. None whatever.

GEORGE F. BARKER.

Sworn and subscribed to before me this 14th day of March, 1885.

FRED. M. OTT,
Special Examiner.

DEPOSITION OF ALONZO F. MC GAFFICK.

February 2, 1885, 8 P. M.

Present—For complainants Messrs. Dickerson and Storrow; for defendants Mr. Hill.

Alonzo F. McGaffick being produced, sworn and examined on oath, saith:

Examined by Mr. Hill:

My age is thirty-three; residence Beaver, Pennsylvania; occupation fruit-tree agent, now; I am a printer by trade.

Q. 1. Did you ever reside in Harrisburg, Pennsylvania?

A. Yes, sir; I first came to Harrisburg in the late summer or early fall of 1873, and was there most all the time until in 1877 along in the summer.

Q. 2. While you lived in Harrisburg did you ever go on any fishing excursions over in Cumberland county?

A. Yes, sir; I was over there once, that is on a fishing excursion; I have been in Cumberland county a number of times, but only once on a fishing excursion.

Q. 3. Was anybody with you on that fishing excursion; if so, who?

A. Yes, sir; I went there with Dr. Updegraff, of Harrisburg, and Joseph Boyle, and a gentleman by the name of Stackpole; I don't remember his first name.

Q. 4. Did anyone else join the party?

A. I think a gentleman by the name of Smith came over the next morning.

Q. 5. Where did you stop over night during the excursion?

A. On a little island in the Yellowbreeches creek.

Q. 6. How far was that island from Milltown or Eberly's mills?

A. But a short distance; I don't know exactly how far.

Q. 7. Did you go up to the village of Milltown while you were encamped on that island?

A. No, sir.

Q. 8. While you were encamped on that island, or while you were on that fishing excursion, did you go to the shop

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or old mill occupied by Daniel Drawbaugh, on the banks of the Yellowbreeches, about a couple of hundred yards below the village of Milltown?

A. No, sir; I think not.

Q. 9. Were you ever in that shop or mill?

A. No, sir; not that I can mind of; but I believe that Dr. Updegraff was there at that time, and, I think, Mr. Stackpole; I am not positive about Stackpole, but think I heard Updegraff say, after he came back, that he was at the mill?

Counsel for complainants objects to so much of the answer as relates to anything said by Updegraff, as not competent testimony.

Q. 10. Were you keeping house or boarding at the time of that fishing excursion?

A. Boarding; I never kept house in Harrisburg.

Q. 11. With whom were you boarding at that time?

A. Dr. C. E. Updegraff.

Q. 12. In what house was Dr. C. E. Updegraff living at the time of that fishing excursion?

A. A house on the corner of Fourth and Market streets.

Q. 13. Do you know who his landlord was?

A. I think a gentleman by the name of Strouse.

Q. 14. How long did you board with Dr. Updegraff in that house?

A. Well, about a year, lacking a week or two perhaps; he moved there the 1st of April, and I went to board with him either the first or second week he lived there.

Q. 15. About the 1st of April in what year did he move into that house?

A. In 1875.

Q. 16. And do you mean to be understood that he moved out of there on the 1st of April, 1876?

Objected to as leading.

A. Yes, sir; he moved away from there on the 1st of April, 1876.

Q. 17. In what year was it that you and the party you have referred to went on the fishing excursion over to the Yellowbreeches creek?

A. In the year 1875.

Q. 18. And about what time of year?

A. In the month of June or July, but, I think, June.

Q. 19. From what house did the July excursion start?

A. Dr. Updegraff.

Q. 20. What was the business of Mr. Boyle, whom you mention as being one of the party?

A. He was a compositor or printer.

Q. 21. Do you know how he happened to leave his work and go on a July excurson at that time?

A. I think he was sick; he was sick a good bit that summer.

Q. 22. Do you know whether or not he was connected with some of the Odd Fellows lodges in Harrisburg, at that time?

Objected to as leading.

A. Yes, sir; he was—the lodge known, I believe, as the Lamberton lodge.

Q. 23. Do you know whether or not he drew any benefit from the lodge as the result of his sickness?

Same objection, and further that the witness had no means of knowledge.

A. He told me that he did.

Answer objected to by counsel for complainants, as leading.

Q. 24. When did he tell you that?

Same objection.

A. About the time we went on this fishing excursion.

Q. 25. How happened the matter to come up as a subject of conversation, and what was said about it at that time?

Same objection.

A. Well, we worked in the same office, and I got a furlough for a few days, on account of either being ahead of the forms or the rollers had melted, and, of course, I was off wages, and the conversation came up if I belonged to the Odd Fellows and was sick I would be receiving ten dollars a week. We were twitting Boyle because we

thought he was playing off about his being sick while his furlough was going on, and about his getting ten dollars a week. Of course, then, we knew that he was sick, but that conversation would come up when we would be in his room to see him or in the parlor.

Q. 26. You were joking with him about it, if I understand you; is that the idea?

Objected to.

A. Yes, sir; I had no doubt but what he was sick.

Q. 27. Where was Boyle living at that time?

A. He was living with Dr. Updegraff.

Q. 28. Did he board with Dr. Updegraff some time?

A. About two years.

Q. 29. Do you know whether that trip on which you went with Dr. Updegraff, Mr. Boyle and others over to the Yellowbreeches creek on a fishing excursion, was or was not the first time that Dr. Updegraff and Mr. Boyle had been over there on a fishing excursion together?

A. I think it was not the first time.

Q. 30. Have you or not any recollection of their being over there on some prior occasion?

Objected to as leading.

A. Yes, sir.

Q. 31. How long was it before the trip on which you accompanied them?

A. But a short time before; I can't just state how long.

Q. 32. Do you remember anything about the boat that they used on that trip before you went with them?

A. Yes, sir; the doctor had got up a canvas boat, and they took it along with them.

Q. 33. Do you know what the condition of the boat was when it came back?

A. Yes, a bad condition, they either struck a snag or stone, and tore a hole in it.

Q. 34. After they returned from that first trip, on which they used the canvas boat, did you hear either of them mention anything remarkable that they had seen while on the trip?

Objected to as calling for hearing.

A. Yes, sir; I believe so.

Q. 35. What was it?

Same objection.

A. Why, something that they called a talking machine.

Q. 36. How long after they returned did you hear them speak of this talking machine?

A. I believe the first evening.

Q. 37. Did they state where they had seen it?

Same objection.

A. Yes, sir; over at some old mill.

Q. 38. Did they state who had it there at the old mill, and if so, do you remember the name?

Same objection.

A. Well, I am not just positive, but think it was Drawbaugh, or some such name.

Q. 39. Did you understand from them, at the time, that either of them had talked through the machine?

Objected to as leading, as calling for hearing, and as not calling for the witness' recollection.

A. It is my recollection that the doctor had; I am not positive whether Boyle stated that he had or not.

Q. 40. Was there much or little conversation at Dr. Updegraff's while you boarded there with regard to that talking machine?

Same objection.

A. Oh, a great deal.

A. F. McGaffick.

Cross-examination waived by Counsel for Complainants.

Sworn and subscribed before me this second day of February, 1885.

Fred. M. Ott, Special Examiner.

Adjourned until February 3rd, 1885, at 10 A. M.

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Feb. 3d, 1885, 10 A. M. Examination resumed pursuant to adjournment.

Present—Same counsel.

Henry Brenizer being produced, sworn and examined, saith:

Examined by Mr. Hill:

Q. 1. Please state your name, age, residence and occupation?

A. My name is Henry Brenizer, but I sign my name "Harry;" my age is forty-six; I reside at 831 McKean street, Philadelphia, Pa.; I am a printer.

Q. 2. Did you formerly reside in Harrisburg, Penna.?

A. Yes, sir.

Q. 3. While there, were you acquainted with Dr. C. E. Updegraff, then of Harrisburg?

A. Yes, sir.

Q. 4. Did you ever board with him in Harrisburg?

A. Yes, sir.

Q. 5. When did you commence to board with him?

A. The last week in April, 1875.

Q. 6. In what house was he living at that time?

A. At the corner of Fourth and Market streets, Harrisburg.

Q. 7. Do you know whom he rented the house of?

A. Benjamin Strouse.

Q. 8. When he moved away from that house, what house did he move his family into?

A. On Fourth street, above Market.

Q. 9. And do you know whom he rented that house from?

A. Mr. Young.

Q. 10. While you were living with Dr. Updegraff, did you know two gentlemen named Joseph M. Boyle and A. Frank McGaffick?

A. Yes, sir.

Q. 11. Do you know where they were boarding at the

time you were boarding with Dr. Updegraff in the house at the corner of Fourth and Market streets?

A. At the same place.

Q. 12. Did you work with them at the same printing office, or at different offices?

A Different offices.

Q, 13. Were you an Odd Fellow?

A. Yes, sir.

Q. 14. Did you and Boyle belong to the same lodge, or different lodges?

A. The same lodge.

Q. 15. Can you tell us whether or not Mr. Boyle was on the sick list of the lodge at any time while you and he boarded with Dr. Updegraff, on the corner of Fourth and Market streets?

A. He was.

Q. 16. Did you know anything about Dr. Updegraff, Mr. Boyle, Mr. McGaffick and others going on any fishing excursions together?

A. I do.

Q. 17. Do you know where they went?

A. Up the Cumberland Valley to Milltown, or Eberly's Mills, as they call it.

Q. 18. When was that?

A. That was in 1875.

Q. 19. According to your best recollection, about how long was it after you went to board with Dr. Updegraff at the corner of Fourth and Market streets?

A. During that summer.

Q. 20. After their return from that fishing excursion, do you remember hearing any talk among them about where they had been, or what they had seen, or not?

Objected to as calling for hearing.

A. They were speaking about a talking machine.

Q. 21. Do you remember whether they stated where they had seen the talking machine, or whose talking machine it was?

Same objection, and as leading.

A. Milltown; Drawbaugh's talking machine.

Q. 22. Where did this conversation take place at which you heard them speaking of Drawbaugh's talking machine?

Objected to as calling for hearing.

A. At Dr. Updegraff's house, at the dinner table.

Q. 23. Which house was that?

A. At the corner of Fourth and Market streets, Harrisburg.

Q. 24. Did any of them say whether they had or had not talked through the talking machine, or heard talking through it?

Same objection.

A. Dr. Updegraff said he talked through it.

Cross-examined by Mr. Dickerson:

X-Q. 25. Who lived in the house with Dr. Updegraff on Fourth street above Market?

A. He kept boarders; there was a man by the name of Frank McGaffick, Joseph Boyle, William Goldsmith, William Irvin; that is all, I believe, but his family and servant girl.

X-Q. 26. Did you board with him also?

A. Yes, sir.

X-Q. 27. Who first talked to you about the conversation that you heard between Dr. Updegraff and the other persons you have mentioned; and when was it that you were first spoken to about it?

A. Dr. Updegraff was speaking of it at the dinner table, during the summer of 1875.

X-Q. 28. You do not understand the question. When was it that you were first spoken to by some one else with reference to the conversation of 1875; and who spoke to you about it?

A. Dr. Updegraff, Joseph Boyle and Frank McGaffick were talking about it at the dinner table.

X-Q. 29. Can you tell us when it was that somebody reminded you that such conversation had been had in your

presence in 1875, and who the person was who first reminded you of such conversations?

Objected to as assuming and misleading.

A. The conversation took place at the dinner table, between Dr. Updegraff, Joseph Boyle and Frank McGaffick.

X-Q. 30. Since the date of that conversation, and until you were examined here today, hasn't somebody spoken to you about that conversation, reminding you of it and bringing your memory to it; and if so, when were you so reminded of the conversation, and by whom?

A. I remember that conversation distinctly at the dinner table.

X-Q. 31. But you have forgotten, have you, when any person spoke to you about it since that date, and who that person was, and what he said?

A. No, sir; no one spoke to me.

X-Q. 32. Then, the first time that you have told that story to any one since 1875 was today, when you were examined; is that so?

A. Yes, sir.

Re-direct by Mr. Hill:

Q. 33. You have evidently misunderstood Mr. Dickerson's questions, and I will endeavor to put the question so that you will understand it. Who first spoke to you about giving testimony in this case?

Counsel for complainants objects to the method of instructing the witness to retract his testimony, and says that the witness hasn't said that he misunderstood the question, and there is no evidence whatever that he has misunderstood it.

A. Dr. Updegraff.

Q. 34. How long ago?

A. About three weeks ago.

Re-cross by Mr. Dickerson:

X-Q. 35. Do you wish to retract your answer to the 32d question?

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A. I misunderstood you.

X-Q. 36. Whom did you understand by that question when you said that this was the first time that you had told that story to any one since 1845?

Respondent's counsel objects to the statement on the ground that the witness has not stated that this was the first time that he had told the story to any one since 1845.

A. I understood he asked me whether any person had spoken to me today.

X-Q. 37. Tell us exactly what Dr. Updegraff said to you three weeks ago about this subject, and exactly what you said to him?

A. Well, he came down to my house one Sunday morning and told me he wanted me as a witness in this case, and asked me whether I remembered when I boarded with him, when he was living at the corner of Fourth and Market streets. I told him yes, I remembered when I boarded there. I told him I came to board with him about the latter part of April or first week in May, in the year 1875. He said he didn't know exactly when he would want me. Then we talked about family matters.

X-Q. 38. Was that all the conversation between you with regard to this subject?

A. Yes, sir.

X-Q. 39. Since 1875, with the exception of this conversation with Dr. Updegraff, have you told the story which you have sworn to here to other persons?

A. No, sir.

HARRY BRENIZER.

Sworn and subscribed to before me this 3d day of February, 1885.

FRED. M. OTT, Special Examiner.

DEPOSITION OF JOSEPH M. BOYLE.

FEB. 3, 1885, 8 P. M.

Present: Same counsel.

Joseph M. Boyle, being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is thirty-five; residence Cincinnati, Ohio; I deal in a patent medicine.

Q. 1. Were you formerly a printer by occupation?

A. Yes.

Q. 2. Did you ever work at the printing trade at Harrisburg, Pennsylvania?

A. Yes, I did.

Q. 3. In what years?

A. I think I went there in 1872, and worked there 1873, 1874, 1875, 1876 and part of 1877.

Q. 4. While you lived in Harrisburg, did you know Dr. C. E. Updegraff, who lived there?

A. Yes, sir.

Q. 5. Did you ever board in his family at Harrisburg?

A. I did.

Q. 6. When did you commence boarding in his family there?

A. I commenced the first week in April, in 1875.

Q. 7. What house was Dr. Updegraff living in when you first commenced to board with him?

A. He lived in Strouse's house, on the corner of Fourth and Market.

Q. 8. Do you remember when he moved his family out of that house, and to what house he moved them?

A. He moved on the 1st of April, 1876, to a frame house next to the express office, on Fourth street.

Q. 9. Was that frame house between Market and Walnut streets?

A. It was.

Q. 10. Do you know whom his landlord was from whom he rented the frame house on Fourth street, between Walnut and Market?

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A. Yes, sir; it was Mr. Young—a butcher, I believe.

Q. 11. During the Centennial year—1876—where did Dr. C. E. Updegraff spend the most of his time?

A. In Philadelphia.

Q. 12. Did you board with his family in the frame house on Fourth street, between Market and Walnut streets, after they moved there from the house on the corner of Market and Fourth?

A. I did as long as they lived there.

Q. 13. Then, when the family moved from the house on the corner of Market and Fourth to the frame house on Fourth street, you moved with them, did you?

A. I did.

Q. 14. For the first two or three months after you went to board with Dr. Updegraff, in April, 1875, what was the condition of your health?

A. I was sick most of the time, suffering from dyspepsia, or lead poisoning.

Q. 15. Were you at that time a member of the fraternity of Odd Fellows?

A. I was.

Q. 16. In what particular bodies, lodges or encampments were you connected at that time?

A. I belonged to Dauphin Lodge, No. 160, and Dauphin Encampment, No. 10.

Q. 17. Mr. A. Frank McGaffick testified here last evening that he thought you belonged to the Lamberton Lodge; was he correct in that or not?

Objected to.

A. He was not correct.

Q. 18. Was Mr. McGaffick himself an Odd Fellow so far as you know?

A. He was not an Odd Fellow at that time.

Q. 19. I believe that one of the rules of the Odd Fellows' fraternity requires that provision should be made for the pecuniary assistance of sick members in certain cases; did you ever receive such assistance from the fraternity when you were sick at any time?

A. I did.

Q. 20. When?

A. Four weeks in June, 1875.

Q. 21. How did you occupy yourself during your sickness that summer when not able to work?

Objected to as leading.

A. I wasn't sick enough to remain in my room, and consequently was out of doors as much as possible.

Q. 22. Did you go on any fishing excursions that spring or summer, or not?

Same objection.

A. I did.

Q. 23. Mention where you went on any of those fishing excursions?

A. On one occasion I went to Rockville, Dauphin county, I think, about five miles above Harrisburg; twice I went to Yellowbreeches creek, and once to Stony creek.

Q. 24. Who, if anybody, went with you on your two fishing excursions to Yellowbreeches creek?

A. The first time Mr. Jordan drove Dr. Updergraff and I to John Zacharias' mill; and on the second trip Dr. Updegraff, Frank McGaffick, and a Mr. Smith and a Mr. Stackpole and myself.

Q. 25. On the second trip, when Messrs. Smith, McGaffick, Stackpole, Updegraff and yourself went together, how did you go over to the Yellowbreeches?

A. We went on the cars to the station, and walked over to the creek.

Q. 26. At what time did this second fishing excursion to the Yellowbreeches take place?

A. I believe it was in June.

Q. 27. And in what year?

A. 1875.

Q. 28. Was it before or during or after the period of your drawing the relief benefits from the Odd Fellows' fraternity?

A. It was while I was drawing benefits from the Odd Fellows.

Q. 29. Referring now to the first fishing excursion which you made to the Yellowbreeches, when Mr. Jordan drove you and Dr. Updegraff over to Mr. Zacharias' mill, was that while you boarded with Dr. Updegraff, or before.

A. That was while I was boarding with Dr. Updegraff.

Q. 30. In what house were you boarding at the time of that first excursion with Dr. Updegraff?

A. On the corner of Fourth and Market.

Q. 31. And in what house were you boarding at the time you made the second excursion to the Yellowbreeches, which you have mentioned?

A. The same house—corner of Fourth and Market.

Q. 32. When you started on the expedition with Dr. Updegraff, with Mr. Jordan as driver, what house or place did you start from?

A. Dr. Updegraff's house, corner of Fourth and Market.

Q. 33. And when the expedition, consisting of yourself, Dr. Updegraff, Mr. McGaffick and others, started on your second trip to the Yellowbreeches, what house or place did the party assemble at and start from?

A. I think we all assembled at Mr. Smith's house down by the railroad.

Q. 34. Referring to your first trip to the Yellowbreeches, when Mr. Jordan drove you and Dr. Updegraff over to Mr. Zacharias' mill, how long was that trip after you first began to board with Dr. Updegraff's family?

A. I think it was about three or four weeks.

Q. 35. Was or was not that first trip made while you were receiving sick-benefits from the Odd Fellows' lodge?

Objected to as leading.

A. I was not receiving benefits from the Odd Fellows' lodge on that first trip.

Q. 36. Did you do any work at your trade after you got back from that first trip, and before you began receiving sick-benefits from the lodge; and if so, how much, if you remember?

A. I believe I worked two weeks after I came back from that trip, before I got sick and reported myself on the sick

list; but I didn't report myself to the lodge as soon as I quit work.

Q. 37. During your first trip to the Yellowbreeches with Dr. Updegraff, as you have testified, did you stay over night in the country; and if so, how many nights?

A. We stayed two nights—one night at John Zacharias' mill, and the last night at—Milltown, I believe, is the name of the place.

Q. 38. Do you remember what the condition of the weather was, as to heat or cold, during the night that you stayed at Zacharias' mill?

A. It was pretty cold; we had to keep a fire up nearly all night to keep comfortable.

Q. 39. Did you stay in Zacharias' mill that night?

A. No; we staid on the banks of the creek.

Q. 40. Did you have any shelter there to sleep under; if so, what?

A. We had a canvas boat, which we arranged into a tent or covering to keep the dew off of us.

Q. 41. Do you know to whom that canvas boat belonged?

A. It belonged to Dr. Updegraff.

Q. 42. Do you know when it was made, or who made it?

A. Dr. Updegraff and I made it some time very shortly after we moved into his house, on the corner of Fourth and Market.

Q. 43. Where did you make it?

A. He made the frame in the cellar, I believe, of that house; and we nailed on the canvas, and oiled it in the back yard.

Q. 44. After staying over night on the banks of the Yellowbreeches creek, near Zacharias' mill, as you have testified, what did you do the next morning and through the day?

A. The next morning, about nine o'clock, we loaded up the canvas boat and started it floating down the creek to the next mill; we snagged the boat going over the riffles pretty soon after starting, so I got out and walked, and Dr. Updegraff took charge of the boat until we got to Milltown,

where there was a flat-bottom wood-boat, which he brought over, and rowed me across the creek to the Milltown side; we got there, I think, about noon, and encamped on the little island.

Q. 45. How long did you camp on the little island?

A. We fished around there from that time till some time about dusk; we intended to sleep there all night; Mr. Drawbaugh came down about dusk or some time in the evening, and invited us up to his mill or workshop to sleep; he said it was too cold to sleep down along the creek that night.

Q. 46. Did you accept his invitation?

A. We accepted his invitation, and went up to the mill then.

Q. 47. And staid in the mill over night?

A. And staid in the mill over night.

Q. 48. Did Mr. Drawbaugh go into the mill with you?

A. He did.

Q. 49. How long did he remain in the mill with you and Dr. Updegraff that night?

A. He staid the biggest part of the night.

Q. 50. What time did you go to bed that night?

A. I was not feeling very well, and I laid down pretty soon after I got to the mill.

Q. 51. At what time did Dr. Updegraff go to bed that night?

A. He didn't lay down until after Mr. Drawbaugh left us; it might have been midnight, or it might have been later.

Q. 52. How did Dr. Updegraff and Mr. Drawbaugh spend their time in the shop that evening?

A. Talking.

Q. 53. What were they talking about, so far as you remember?

A. I remember of their talking about Dr. Updegraff's father's perpetual-motion machine; about a patent axle, which Mr. Drawbaugh said he was preparing to manufacture; about Mr. Drawbaugh's talking machine and other machines.

Q. 54. Which one of these machines did Mr. Drawbaugh appear to take the greatest interest in, so far as you remember?

Objected to, unless the witness has his likeness or some other means of letting the court see his appearance.

A. I don't know that I could answer that.

Q. 55. Do you remember which one of the machines Mr. Drawbaugh and Dr. Updegraff talked most about that evening, so far as you heard their conversation?

Objected to as leading, and because the witness has already testified all he knows on the subject.

A. The first talk about the perpetual-motion machine; about the axle; and the last and longest conversation was about the talking machine.

Q. 56. Did you hear all of their conversation about the talking machine, or not?

Objected to as an attempt to make the witness state what the conversation was when he did not hear it.

A. I suppose I heard it all; I couldn't repeat it; if I heard any of it, I could hear it all, as long as Mr. Drawbaugh was in the mill.

Q. 57. Did Mr. Drawbaugh show you or Dr. Updegraff any of his talking machines that evening in the mill, or not?

Objected to as leading.

A. I don't remember of seeing any myself; he showed it to Dr. Updegraff; I suppose I could have seen it, if I had went over where they were.

Q. 58. What were you doing at the time when he showed the machines to Dr. Updegraff?

A. I was lying down on the table—on a bench or table.

Q. 59. Did they do anything with the talking machines besides look at them, or not?

Objected to as leading.

A. Mr. Drawbaugh left the mill after they had been looking at the machines and talking awhile, and Dr. Updegraff staid there; and he said to me that he could hear

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talking through this machine—heard Mr. Drawbaugh, I guess, through this machine; Dr. Updegraff said, "Yes, that's plain;" Mr. Drawbaugh very shortly after that came back into the mill again, and they resumed their conversation.

Q. 60. When you heard Dr. Updegraff say "Yes, that's plain"; to whom did he make that remark?

A. My impression was that it was to Mr. Drawbaugh.

Q. 61. Where was Mr. Drawbaugh at the time when Dr. Updegraff remarked "Yes, that's plain"?

A. He was not in the room with us; I thought then he was at his house or in the lower room of the mill, but I can't say positively where he was.

Q. 62. Did you understand at the time, that Dr. Updegraff made the remark to Mr. Drawbaugh through the talking machine, or how?

Objected to as leading and incompetent.

A. Through the talking machine, because he was showing the machine to Dr. Updegraff and showing him its workings?

Q. 63. Did you understand at the time, how or by what agency the talk was transmitted over the line from one person to another?

Same objection.

A. I understood it to be electricity—the same as a telegraph wire or machine.

Q. 64. While Mr. Drawbaugh was out of the room, did you hear the sound of his voice or was he out of the range of your ears, if he spoke?

A. I didn't hear his voice.

Q. 65. Since speaking telephones were introduced into public use, have you ever had one in your business place for use?

A. I have.

Q. 66. Do you understand the construction of them?

A. I do not.

Q. 67. Have you ever seen the inside of one—the works?

A. I have not.

Q. 68. Do you understand what the means or agency is by which words are transmitted over a telephone line from one operator to another?

A. I understand the agency to be electricity.

Q. 69. When Mr. Drawbaugh and Dr. Updegraff were operating the talking machine there that night, so far as you witnessed at Dr. Updegraff's end of the line, how was the machine operated—by operating some mechanical instrumentality or by simply talking into the machine and listening at it?

Objected to as leading.

A. I don't remember anything more than Dr. Updegraff standing there and talking—listening; I hardly think he talked, that is the only thing that is fresh in my mind now, is the words "Yes, that's plain."

Q. 70. How long did you stay about the vicinity the next morning after you slept in the shop?

A. As soon as it was light we went down to the creek and commenced fishing.

Adjourned until Feb. 4th, 1885, at 10 A. M.

Feb. 4th, 1885, 12 o'clock noon, examination of James M. Boyle resumed.

Q. 71. Soon after the adjournment last evening you came to me and asked if you could correct your testimony in any particular, and upon being informed that you could, you stated that you had a correction which you wished to make. You have the opportunity now of making any correction which you may desire to make?

A. I believe I stated last night that Dr. Updegraff didn't talk through the machine, and only said: "Yes, that's plain." I don't remember the convesation that he did have through that machine, but he did stand there and talk—had such a conversation as a man would have who was testing a machine. I suppose he stood there fifteen or twenty minutes talking and listening.

Q. 72. Then, if I understand you now correctly, you

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heard the conversation, but don't remember any of it, except the words: "Yes, that's plain," is that the idea?

A. That's all I remember—all that I could repeat now of the conversation—although it was quite lengthy.

Q. 73. How happened you to come to me last night and request the privilege of making this correction; and how did the correction occur to your mind?

A. As I left the hotel, I thought the way I answered the question, that I had left the impression with you that Dr. Updegraff only spoke those words: "Yes, that's plain," when I knew he had quite a lengthy conversation through this talking machine.

Q. 74. And when that thought occurred to you, as you left the hotel, what did you do?

A. I intended not to say anything about it until I was put on the stand again, but I had occasion to come back to the hotel again to buy a *Sunday Cincinnati Inquirer* to take to my room, when I met Judge Hill and asked him whether I could make the correction.

Q. 75. How long was it after you left this room, at the end of your testimony here, last evening, that you met Judge Hill and asked him whether you could make the correction?

A. It wasn't more than fifteen minutes.

Q. 76. During that time, had anybody been talking to you about your testimony, or you been talking to anybody about it?

A. I didn't see a person that I knew, or speak a word to anybody, from the time I left the hotel until I got back. If I had met anybody to talk to, I wouldn't have come back for the *Inquirer*. I wanted that to put in the time until I got ready to go to bed. I walked right down to the Washington hotel, and returned immediately.

Q. 77. And how was it from the time when you left this room to the time you left this hotel. Did anybody have any talk with you about it, or in your presence, during that time?

A. Nobody had any talk with me about it; there was no talk about it in my presence.

Q. 78. Will you state whether anybody, in any way suggested the correction, or prompted you to make it?

A. Nobody suggested it to me, or talked to me about it, from the time I left the room until I got back to the hotel and spoke to Mr. Hill about it; and then I spoke voluntarily, because I wanted to make myself clear on that point.

Q. 79. Resuming now your examination where I left it off last evening, and referring to the afternoon on your first fishing excursion to the Yellowbreeches, when you had arrived at the little island near Mr. Drawbaugh's mill or shop, and before you went into the shop to sleep, did you, or did you not, during that afternoon, go up to the village of Milltown?

A. We both went up to the village of Milltown, and stopped in a little store or grocery, bought some segars—a few stogies, I believe, and bought some butter and eggs and potatoes. On our way back we stopped at a house and bought some milk.

Q. 80. By "we both" I suppose you mean Dr. Updegraff and yourself, do you?

A. Dr. Updegraff and myself.

Q. 81. Do you remember where that little store, as you call it, was located—what course you took to go to it from the island?

A. It was a little frame house about half way up the hill, on the right hand side going up. We passed Drawbaugh's mill to the left and the grist mill on the right.

Q. 82. In going in that direction the road divides at the grist mill, one fork turning to the right around the grist mill crossing the Cedar run, and extending in a northerly direction towards the White Hill station, and the other fork proceeding directly forward up the hill in a westerly direction; in going to the store which fork of the road did you take when you arrived at the grist mill?

Objected to as instructing the witness with respect to the topography of the place about which he is being examined, and, therefore, grossly leading.

A. We took the road leading directly through the town, and not the road leading to White Hill station.

Q. 83. Describe the little store or grocery, as you call it, to which you went that day?

A. It was in a one story frame house. After we got inside it didn't seem to have the appearance of being a grocery. The only thing that showed me that it was a grocery was two or three candy jars in the window, which I had seen from the outside. My impression is, there was no counter there, things set around the floor and on boxes and tables.

Q. 84. Referring now to your second fishing excursion to the Yellowbreeches, how many days did that excursion occupy?

A. We left Harrisburg after taking an early dinner there one day, and came back and took dinner there the next day.

Q. 85. Where did you stay over night between the two days?

A. On the same island.

Q. 86. Did you use any boat or boats during that excursion?

A. We used the same flat-bottomed boat which we used on the first fishing excursion—which belongs there in the creek—to I don't know who, perhaps to the grist mill.

Q. 87. While on that second fishing excursion did you go up to the village of Milltown?

A. I did not go up myself. Dr. Updegraff and Smith went up and bought some provisions the next morning?

Q. 88. State whether or not you were in Mr. Drawbaugh's shop at any time during that second fishing excursion?

A. I was not in his shop on the second excursion.

Q. 89. During that second excursion where was Dr. Updegraff's canvas boat?

A. It was in Dr. Updegraff's back yard, in Harrisburg, a wreck.

Q. 90. Do you know whether or not Dr. Updegraff ever

made, or commenced to make, a second canvas boat, after the wreck of the first one?

A. He told me that him and Bill Leedy were making a second one, on a different plan; but I never seen it.

Q. 91. When did he tell you that?

A. Some time after we found out that ours wouldn't work—wasn't safe in the water or river; I don't know exactly what month it was—some time in the summer.

Q. 92. From your not seeing that second boat, I infer that it was not made at Dr. Updegraff's private residence; am I correct in this, or not?

Objected to as leading.

A. It was not made at his residence; he had no place to make it there without I would see it.

Q. 93. You have now described two fishing excursions which you made to the Yellowbreeches creek; will you state whether or not you ever went on any other fishing excursion on that creek?

A. I never went on any other fishing excursion on that creek, nor in that direction.

Q. 94. On how many different occasions were you ever in Mr. Drawbaugh's shop in your life?

A. I have been there twice in my life.

Q. 95. When were you there last?

A. About a week ago.

Q. 96. Did you include that trip about a week ago in your answer when you said you had only been in Drawbaugh's shop twice in your life?

Objected to as leading.

A. Yes; that makes the second visit that I made to the inside of the shop.

Q. 97. If I understand you correctly, that visit about a week ago, and the visit when you and Dr. Updegraff slept in Mr. Drawbaugh's shop, as you have testified, are the only two occasions when you were ever in that shop?

Same objection.

A. Yes; that's the only two occasions I was ever in his shop.

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Q. 98. When you were there about a week ago, at Milltown, did you or did you not see the building in which the groceries were kept when you were on the fishing excursion in the spring or early summer of 1875, as you have testified?

A. The building is still there, and I seen it on this last trip, about a week ago.

Q. 99. How near is it to Mr. Clendennin's store there?

A. It is the next house to the store in which the post office is now situated, within a stone's throw of the post office.

Q. 100. Is it the same side of the road as the post office, or is it on the opposite side?

A. It is on the same side of the road as the post office.

Q. 101. Is it situated up the hill or down the hill from the post office?

A. Up the hill.

Q. 102. Do you know what it is used for now?

A. It is a dwelling house now exclusively: it was a store before.

Q. 103. Do you know whether or not when the groceries were kept in it in 1875, it was occupied also as a dwelling house?

A. Whoever kept the grocery in 1875 lived in the same building, because the man who sold us the butter called a woman, and she got the butter out of another room.

Q. 104. What has become of the Mr. Jordan who drove you and Dr. Updegraff over to Zacharias' mill, on the occasion of that first fishing excursion?

A. He has mysteriously disappeared. His body has never been found, and nobody knows whether he is dead or alive, to my knowledge. He mysteriously disappeared—in 1880, I think it was.

Q. 105. Before you visited Zacharias' mill with Dr. Updegraff, as you had testified, had you ever been at Zacharias' mill or not?

A. I had never been at Zacharias' mill that he owned in 1875; I had visited him, I think, at his mill at New Cumberland.

Q. 106. How long was that before your trip to his mill with Dr. Updegraff, in 1875?

A. About a year before that. It was on Sunday, and green corn was on the table for dinner.

Q. 107. On your second fishing excursion with Dr. Updegraff to the Yellowbreeches, in 1875, did you visit Zacharias' mill?

A. No, sir; I did not.

Q. 108. Do you remember whether or not, after your visit to Drawbaugh's shop with Dr. Updegraff, Mr. Drawbaugh's talking machine was ever the subject of conversation at Dr. Updegraff's house, in your presence?

A. It was frequently the subject of conversation at the table and in the sitting-room, among the boarders and with the doctor.

Q. 109. In what house?

A. The house he lived in on the corner of Fourth and Market.

Recess until 2.30 P. M.

Cross-examined by Mr. Dickerson:

X-Q. 110. When you left Harrisburg in 1877, where did you go to reside, and in what pursuit were you occupied?

A. I went to my father's home in Lebanon, Ohio, and staid there till fall, and then went to Columbus and went into the printing business.

X-Q. 111. What do you mean by the printing business; and how long did you remain in it, in Columbus?

A. I set type for one or two years, about the town in different offices, and then went in and started a daily paper of my own, with other partners, called the *Columbus Courier:* I published that two years.

X-Q. 112. Are you still engaged in publishing that paper, and if not, when did you give it up?

A. I am not engaged in publishing that paper; I think we gave it up some time in 1880—in the spring of 1880.

X-Q. 113. In what street and what number in Columbus, Ohio, was your establishment, whatever it was?

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A. I think it was 19 Pearl street; we first started it in the office of Nevins & Myers, who were then the State printers; we then moved to Pearl street, opposite the post-office; I am pretty certain the number was 19.

X-Q. 114. Who were your partners?

A. It was a stock company.

X-Q. 115. Who were the officers and managers of this stock company, and what was its title?

A. M. A. Taylor was president; Frank K. Raymond, secretary; and I was the treasurer and manager of the concern; the title of the company was the "Daily Labor Publishing Company;" when we first started, we called the paper the *Daily Labor;* we afterwards changed it to *Daily Courier.*

X-Q. 116. Was it an incorporated company, and what was its capital stock?

Objected to as immaterial and irrelevant, both to the subject-matter of the suit and of the examination in chief.

A. It was an incorporated company. The capital stock, I believe, was ten thousand dollars.

X-Q. 117. Was the capital paid up in full? And if so, how much of it did you pay up?

Same objection.

A. I don't know whether it was paid up or not, now; I know mine was paid up. I had seventeen shares, paid up, out of a hundred.

X-Q. 118. Do you mean to say that you forget whether the capital stock was paid up in full, or that you never knew whether it was?

Same objection.

A. Everybody that had stock had it paid for. At least they could dispose of it if they wished.

X-Q. 119. Do you forget whether the capital stock was paid up in full, or did you never know?

Same objection.

A. I don't remember exactly how much was paid up.

X-Q. 120. Is your memory worse about your own busi-

ness in 1880 than about what you heard said ten years ago?

Same objection, and further objected to as containing a baseless insinuation.

A. I don't know that it is.

X-Q. 121. When that paper stopped, in the spring of 1880, was the corporation dissolved, or do you still keep it going?

Same objection.

A. I suppose it was dissolved. We made an assignment.

X-Q. 122. You said that you set type in Columbus for one or two years. Can't you remember a little closer than that how long it was?

A. I don't think it was more than eighteen months.

X-Q. 123. After that, you published what you called a daily paper of your own for two years, which went out of existence in the spring of 1880. Is it your present recollection that you spent three years and a half in Columbus between the fall of 1877 and the spring of 1880?

A. I spent about three years there altogether. I set type about six months on my own paper.

X-Q. 124. Well, did you spend three years there between the fall of 1877 and the spring of 1880?

A. It might have been less than three years.

X-Q. 125. When you said that you set type for one or two years about town in different offices, and then went in and started a daily paper of your own, with partners, did you include six months' type setting on your own paper in the one or two years about town in different offices?

A. Yes, sir; I did.

X-Q. 126. In the spring of 1880 where did you go from Columbus?

A. I came to Philadelphia, after the paper failed.

X-Q. 127. How long did you stay there, and what did you do?

A. For the first two or three months I didn't do anything particular; I commenced in the early fall of 1880 with Dr. Updegraff in the shell business—in the summer and fall.

X-Q. 128. What month and what day of the month did you commence the shell business with Dr. Updegraff?

A. I don't know what month or what day.

X-Q. 129. Was it a partnership?

A. It was.

X-Q. 130. In writing.

A. No, sir.

X-Q. 131. What were the terms of the partnership?

Objected to as immaterial and irrelevant.

A. Profits and losses were to be divided equally.

X-Q. 132. What was the capital of the partnership?

Same objection.

A. There was nothing said about the capital; we bought the shells whenever we had a chance to buy; would pay for them and sell them again.

X-Q. 133. Did the partnership have no capital; and if it had, who furnished it, and how much?

Same objection.

A. Dr. Updegraff furnished the capital, and gave me a half interest for my services; I don't know how much?

X-Q. 134. Where was the warehouse of this partnership, and what kind of shells did it deal in?

Same objection.

A. 263 South Third street; it dealt in all kinds of shells we could get a hold of—principally ornamental shells—fancy shells; there is no exclusive shell house in the United States that I know of. We had to depend on the sailors coming into this port for our stock.

X-Q. 135. That is, you bought such shells as the sailors from the ships brought home with them, and that was your business. Is that correct?

Same objeetion.

A. We bought from the sailors, we bought from Warner & Merritt, and we bought from Professor Foote, and we bought from any person else who had shells for sale; that was our business.

X-Q. 136. Describe this warehouse, No. 263 South Third street, where your goods were stored?

Same objection.

A. It was Dr. Updegraff's residence. It was a large three or four story brick building. We kept our shells, a great many of them, in the cellar of that building. The office was just built—he built it for the purpose of an office—on the same lot. It was not very grand or elegant inside, but large and comfortable enough for this business.

X-Q. 137. Was the three or four story house used as a warehouse for your shells, or for a boarding house?

Same objection.

A. While I was with him we only used the cellar; soon after I left he used the large front room of that house—up stairs.

X-Q. 138. Wasn't the house a boarding house when you were there?

A. No, sir.

X-Q. 139. Was that office built for what you call the shell business, or for a doctor's office?

Same objection.

A. It was built before I came to Philadelphia. Dr. Updegraff remodeled it to accomodate the shell business after I went with him.

X-Q. 140. Did he carry on his eye and ear doctory there, or did he give that up and devote himself entirely to the shell business?

Same objection.

A. He might have had patients, but not to my knowledge.

X-Q. 141. Did he exhibit a sign as a practicing doctor, at the office or house?

Same objection.

A. I don't believe he did. He might have had a sign—he might have had the same sign he had in Harrisburg, but I don't remember it.

X-Q. 142. Did you board in the house, or elsewhere, and if so, where?

Same objection.

A. I boarded principally at restaurants; sometimes I boarded with him—would take meals.

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X-Q. 143. Did you lodge in that house?

A. I did.

X-Q. 144. Were there any other lodgers besides yourself?

Same objection.

A. I think there was.

X-Q. 145. Then it wasn't a boarding house, but only a lodging house; is that so?

Same objection.

A. As I understand a boarding house or lodging house, it was neither.

X-Q. 146. How long did that partnership continue, and when was it dissolved?

Same objection.

A. It was dissolved some time in the early part of November, 1880.

X-Q. 147. Was there an account stated and the profits divided, or was it allowed to dissolve without any ceremony?

Same objection.

A. We ran the stock down as low as we could, divided the stock and quit business. I shipped a good deal of mine out home.

X-Q. 148. Do you remember your share of the profits resulting from that partnership, and whether it was in money or shells?

Same objection, and this line of cross-examination further objected to as simply wasting time.

A. There was no profits.

X-Q. 149. Were not the shells profit to you, if you brought nothing in and took out shells?

Same objection.

A. No, sir; they were no profit, you can't spend them.

X-Q. 150. Do you mean that you were under an obligation not to spend them, in any way, or that they were not worth anything?

Same objection.

A. I mean I couldn't find a customer for them.

X-Q. 151. Do you know what business the doctor went into when you quit the shell business?

Same objection.

A. I believe he continued in the shell business on a more extensive scale than we were running it.

X-Q. 152. Where did you next go, and in what business, after November, 1880?

A. I commenced type setting again; I worked at Shermans', and worked in several book offices in Philadelphia.

X-Q. 153. How long did you remain in Philadelphia, and where did you go then?

A. I remained in Philadelphia until the latter part of April, 1881, when I went to Lebanon, Ohio, to my father's house. Then I went to Cincinnati—on the 30th of May I arrived in Cincinnati.

X-Q. 154. What business did you go into there?

A. I went there for the purpose of getting capital to go into the ozone business.

X-Q. 155. What is the ozone business?

A. A preserving business—to preserve fruits, eggs and beef.

X-Q. 156. Did you get the capital and go into that business; and if so, who did you get it from, and how did you go into the ozone business?

A. I would like to ask a question: do I have to go into all my private business?

Counsel: I think you do.

Mr. Hill again objects to the unnecessary waste of time in utterly immaterial cross-examination of an entirely irrelevent character.

A. I got the capital from W. S. Coppeller, auditor of Hamilton County, Ohio; I don't understand what you mean by that "how."

X-Q. 157. What did you do in order to carry on what you call the ozone business?

A. We opened up an office on the corner of Ninth and Race, Cincinnati, manufactured what we called ozone powder, or ozone, advertised it extensively and the money came flowing in; the business was all done by mail.

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X-Q. 158. Who do you mean by "we"; was that another partnership?

A. I mean W. S. Coppeller and myself, and our two other partners that we took in after we started the business.

X-Q. 159. How long did this partnership last?

A. It lasted about a year.

X-Q. 160. Did the money stop flowing in then?

A. We stopped advertising and the money stopped coming in.

X-Q. 161. Did you stop advertising because it didn't pay, or because you had made money enough and wanted to go into some other business.

A. I stopped advertising because I had made all the money I wanted out of it, and expected to go to London and start an office there, and I sold out for that purpose.

X-Q. 162. Did the other partners stop advertising for the same reason?

A. You will have to ask the other partners for their reasons for stopping advertising; I don't know them.

X-Q. 163. Did you go to London, and if not, what did you do next?

A. I did not go to London; we started the American Press Association.

X-Q. 164. Who do you mean by "we"?

A. Mr. Coppeller, Mr. Weber, and myself.

X-Q. 165. When was that?

A. That was in February, 1883.

X-Q. 166. What sort of a business was that?

A. That was a business to furnish stereotype plates for daily and weekly papers.

X-Q. 167. What became of your other partners in the ozone business who didn't go into the press business?

A. Mr. Raymond, the only other partner, went to Cambridge and opened up a dry goods store, and is there yet; it is the largest and finest dry goods store in a country town, in Ohio.

X-Q. 168. How long did the press association last?

A. The press business is going on yet—a very fine business.

X-Q. 169. How long did you last in it?

A. I believe I was there about a year; I sold out because I made money by selling out, and because they made a stock company of it, and I didn't want to go into their stock company.

X-Q. 170. What did you go into next, and when, and where?

A. I next took hold of a proprietary medicine, which I call "Dr. Haines' Golden Specific," about eighteen months ago; I am now running it at 185 Race street, Cincinnati.

X-Q. 171. What do you represent that to be a specific for?

A. For drunkenness or the liquor habit.

X-Q. 172. Who is Dr. Haines, whose name you attach to this specific, and where does he reside?

A. Dr. J. W. Haines, of Cincinmati, a regular graduate; he lived at the corner of Elm and Seventh, and run this business from there until I took hold of it; his health is so bad that he has given up practice and business entirely; I believe he is now in New York city.

X-Q. 173. Do you know Moritz Loth, of Cincinnati?

A. I do not.

X-Q. 174. Did you ever hear of him before today?

A. I never heard of him.

X-Q. 175. Did you ever make a statement at the office of a lawyer in Cincinnati, with respect to what you know about the Drawbaugh business?

A. I believe I did.

X-Q. 176. Didn't you swear to it?

A. I believe I did.

X-Q. 177. Wasn't that in the winter of 1881–2?

A. It was.

X-Q. 178. Who was the person for whom, or at whose request you made that affidavit?

A. I don't know.

X-Q. 179. Was he an entire stranger to you?

A. I had never seen him before nor since, to my knowledge.

X-Q. 180. Do you remember what he said to you, in consequence of which you made an affidavit for him?

A. I believe he came to my office and asked me what I knew about this Drawbaugh telephone.

X-Q. 181. Didn't he tell you that Dr. Updegraff had sent him there to hunt you up?

A. I don't remember that he did.

X-Q. 182. Do you remember anything he said?

A. I wouldn't like to undertake to repeat his conversation; I was very busy at that time, and more interested in my own business than I was in anyone else's.

Question repeated.

He asked me what I knew about this Drawbaugh telephone; that is about all I can remember of it.

X-Q. 183. Then the next thing that happened was that you found yourself in a lawyer's office; is that so?

A. No, sir.

X-Q. 184. What was the next thing after he asked you that question?

A. I told him that I didn't want to talk anything about this in my own office, but would meet him that night at his own room at the Gibson house, which I did.

X-Q. 185. Didn't he tell you his name?

A. I have no recollection of his telling me his name.

X-Q. 186. Whom did you ask for when you went to the Gibson House?

A. I didn't go to the Gibson House, but he came back to the office that night about 7 o'clock. I then walked down with him to his room; he got impatient at waiting for me.

X-Q. 187. Do you remember what part of the winter it was?

A. It was pretty cold, I know, that night. He had a fire in the room.

X-Q. 188. Do you think it was in January?

A. It was either in December, January or February; I don't know which.

X-Q. 189. Do you remember what he said to you when he got you to his room?

A. We talked a good while about other things than this Drawbaugh telephone business. He then repeated, I guess, what he asked me in the office—what I knew about the Drawbaugh telephone.

X-Q. 190. Do you remember the appearance of the man; if so, describe him?

A. I don't remember how he looked—have'nt any idea—whether he was a blonde or a brunette.

X-Q. 191. Do you remember anything about his stature—whether he was short, or medium, or tall?

A. I do not.

X-Q. 192. Do you remember how long you spent with him that evening?

A. I wasn't there more than fifteen minutes.

X-Q. 193. When he asked you what you knew about the Drawbaugh business, what did you say?

A. I related briefly my visit to Drawbaugh's mill in 1875, and what I heard there.

X-Q. 194. Do you think you have told him the same story you have told here, or don't you remember?

A. I suppose I told him about the same things; that is all I know.

X-Q. 195. Did you tell him about the grocery store at Eberly's mills, with the things on the floor—not on a counter?

A. No, sir.

X-Q. 196. After being with him fifteen minutes, where did you go that night?

A. I went to supper to the St. Nicholas, and perhaps to the theatre that night.

X-Q. 197. Did you leave the unknown person at the hotel, or did he go with you?

A. I left him at the hotel.

X-Q.198. Did he tell you that there was a lawsuit in which the Drawbaugh people were being sued about the telephone?

A. No, sir; he didn't tell me that the Drawbaugh people were being sued about the telephone.

X-Q. 199. Did he tell you there was a lawsuit about the telephone?

A. He did.

X-Q. 200. Did he tell you why he wanted your statement in connection with that lawsuit?

A. He did not.

X-Q. 201. How did it happen that you went to a lawyer's office the next day?

A. I believe I made an engagement with him to meet some time the next day at the lawyer's office.

X-Q. 202. Who was the lawyer?

A. Levy, Molton and Johnson, I believe, is the firm.

X-Q. 203. Where was their office?

A. On the corner of Fifth and Vine.

X-Q. 204. Lipman Levy is the gentleman, isn't he, of that firm?

A. He is one of the partners—yes, sir.

X-Q. 205. Was he there at the meeting?

A. He was.

X-Q. 206. Who wrote the affidavit that you swore to?

A. I think it was Lipman Levy.

X-Q. 207. Did you dictate it to him or did he write it without that?

A. He wrote it without me dictating it.

X-Q. 208. Do you remember before whom you swore to it?

A. It was a Notary Public in that building; I don't know who it was.

X-Q. 209. When did you last see that affidavit?

A. I have never seen it since that day.

X-Q. 210. Has it been talked about since you have been in Philadelphia?

A. I haven't heard any talk about it; nobody has talked to me about it.

Recess until 8 P. M.

X-Q. 211. Didn't Mr. Lipman Levy talk to you about the case, and tell you whom he represented?

A. I believe he did tell me whom he represented.

X-Q. 212. Whom did he say?

A. I understood that he represented the Drawbaugh telephone company, although I don't know that he called it by that name.

X-Q. 213. But the person who came to see you didn't inform you who the parties were?

A. I understood from him too that it was the Drawbaugh telephone company.

X-Q. 214. Had you had any intercourse with that company before that?

A. I never had any intercourse or heard of them before, only when I was in Philadelphia with Dr. Updegraff and saw an account, I think in the Philadelphia Record, about this suit.

X-Q. 215. When you and Dr. Updegraff went to the Yellowbreeches creek together, where else did you go, besides to Zacharias' mill, before you went to Milltown?

A. We didn't go any place; we drove directly from Harrisburg to Zacharias' mill on our first trip.

X-Q. 216. Didn't you go to Hake's mill or distillery before you went to Milltown?

A. No, sir; I never was at Hake's mill or distillery in my life.

X-Q. 217. Didn't the doctor go to that place or some other place without you after you arrived at the creek and before you went to Milltown?

A. He did not.

X-Q. 218. Didn't you have some whisky in his boat?

A. We didn't have a bit of whisky on the trip.

X-Q. 219. Didn't your boat capsize two or three times going down the creek?

A. It was a canvas boat, and snagged once going over the riffles. I then got out to lighten the load and walked to Milltown.

Question repeated. Repetition objected to by Mr. Hill, because the question has already been fully answered.

A. It did not. It capsized once.

X-Q. 220. Did you get wet when it was capsized?

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A. I got my feet wet; nothing else about me got wet.

X-Q. 221. When you got to the island did you stay there all the afternoon fishing, or did you go into the village?

A. We went into the village a little while.

X-Q. 222. What time was it when you went into the Drawbaugh shop?

A. Just about sundown.

X-Q. 223. Did you and the doctor remain there until the next morning?

A. We did.

X-Q. 224. Were you in the first or second story of the building?

A. We were in the second story.

X-Q. 225. Was the stairway on the inside or the outside at that time?

A. The stairway was on the outside and ran clear to the second story.

X-Q. 226. Were there any beds in there?

A. I didn't see any.

X-Q. 227. What did you sleep on?

A. I slept on the floor; we had blankets of our own.

X-Q. 228. Up to the time that Drawbaugh left you, after midnight, had you gone to bed on the floor or were you lying on a bench?

A. I was lying on a bench.

X-Q. 229. Asleep or awake?

A. I didn't go to sleep until Dr. Updegraff got through talking to Mr. Drawbaugh, when we made our bed on the floor, and him and I went to sleep.

X-Q. 230. About how far from where you were lying on the bench were Dr. Updegraff and Mr. Drawbaugh and the apparatus that they were working with?

A. They were very close to me. I could hear all their conversation—within a few feet of me, I should judge.

X-Q. 231. Had you ever heard of a speaking telephone at that time?

A. No, sir.

X-Q. 232. Did it impress you as a very curious and wonderful thing, or as a matter of course?

A. I wasn't particulary impressed.

X-Q. 233. Didn't you think that an apparatus by which a person could talk to another at a distance by means of a wire was a very wonderful thing?

A. I think so now; I didn't think so then.

X-Q. 234. Did the doctor express any astonishment at it, or did he think it was a matter of course?

A. He thought it was a great thing, and staid up and talked about it half the night to Mr. Drawbaugh. He also talked to me, after Mr. Drawbaugh went away, about the machine. But I had heard him talk about his father's perpetual motion machine and so I thought it was a humbug something like that, and it didn't interest me.

X-Q. 235. When you heard Dr. Updegraff and Mr. Drawbaugh holding up a conversation for twenty minutes over a wire, with Drawbaugh somewhere outside of the building, did you think that was a humbug, and unworthy of your attention?

A. I was tired and sleepy and came there to rest, and I wasn't interested enough in their machinery to get up and investigate it; either the patent axle or anything there was around there.

X-Q. 236. And that is the reason, is it, why you didn't take the trouble to look at the apparatus or speak through it or listen at it, when it was right along side of you, and when your friend Updegraff staid up half the night to talk with it and about it?

A. That was about the reason; yes, sir.

X-Q. 237. And you are sure you had no whisky that day, are you?

A. I think we took a drink of whisky with Zacharias, before we left his mill in the morning, but we had no whisky with us.

X-Q. 238. And after this talking machine had been frequently the subject of conversation at the table and in the sitting-room, among the boarders and with the doctor

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in the doctor's boarding house at Harrisburg, after this first visit and before your second one, were you so tired and sleepy on your second visit that you didn't think it worth while to go and see this wonderful thing, when the doctor and one other of your company left you for the purpose of visiting it?

A. On the second visit, we were crossing the creek in the boat, with four persons in the boat; the boat capsized and we all got wet. I went to the bottom of the creek; when I got out I went to the island and took off all of my clothes, took two or three drinks of that Hake's lightning whisky, wrapped up in a blanket and laid down by the fire to wait until my clothes dry. I got sick and vomited all night; terribly sick from the effect of this whisky. I was very sick the next morning; so sick, I could hardly walk to the train, and was interested in nothing but my own feelings.

X-Q. 239. Was that the reason you didn't see the machines on that occasion?

A. That is the reason I didn't fish or go up to the mill either.

X-Q. 240. What was the object of your visit to Eberly's mills recently?

A. I knew I was to be called as a witness in this case, and wanted to refresh my mind on the location of things there; I hadn't seen it for ten years. I was in Harrisburg besides, and had eight or ten hours to spare and thought it would be a good way to put it in.

X-Q. 241. Who told you that you were to be called as a witness?

A. Dr. Updegraff.

X-Q. 242. What else did he tell you about it?

A. We had no conversation about it whatever.

X-Q. 243. Who requested you to go to Eberly's mills?

A. I went of my own accord. I was the first one to suggest it.

X-Q. 244. Who went with you?

A. Dr. Updegraff, a young fellow named Perrin, I think, from Harrisburg, and the driver.

X-Q. 245. When did you come from Cincinnati?

A. I left Cincinnati a week ago last night.

X-Q. 246. Did you come to Philadelphia first?

A. No, sir; I stopped at Harrisburg over night.

X-Q. 247. Did you meet Dr. Updegraff there?

A. No, sir.

X-Q. 248. Did you come to Philadelphia from Harrisburg the next day?

A. Yes, sir.

X-Q. 249. Then didn't you and Dr. Updegraff return to Harrisburg for the purpose of going to Eberly's mills?

A. No, sir; I havn't been out of Philadelphia since I got here.

X-Q. 250. You left Cincinnati Tuesday night of last week you say and arrived at Harrisburg, when?

A. Thursday morning at two o'clock. I missed the train at Pittsburg and laid there all day Wednesday.

X-Q. 251. When did you leave Harrisburg?

A. Early Friday morning.

X-Q. 252. When did you meet Dr. Updegraff?

A. I met Dr. Updegraff in Cincinnati some time week before last; I don't know exactly the date.

X-Q. 253. Do you know what he went to Cincinnati for?

A. I guess he came there after me.

X-Q. 254. Where did he stay while he was there?

A. I don't know what hotel. He stopped at a European hotel and boarded at restaurants. I think it was the Palace.

X-Q. 255. How long did he stay in Cincinnati?

A. Two or three days.

X-Q. 256. Did you and he come east together?

A. We did.

X-Q. 257. Why did you stop at Harrisburg?

A. I wanted to stop there because I used to live there, and I didn't intend to go back that way; so I thought I would stop as I was coming.

X-Q. 258. Doctor Updegraff lives in Philadelphia, does he not?

A. He does.

X-Q. 259. Did you and Dr. Updegraff have any talk about this case?

A. We did not talk about the case; no, sir.

X-Q. 260. Did you and the doctor have any talk about your fishing excursions?

A. I suppose we talked about that; we talked about old times, generally.

X-Q. 261. Didn't you talk more especially about those fishing excursions than you did about other old times?

A. I don't think we did—no; we were talking business all the way coming here.

X-Q. 262. Who told you that there was any question in this case about the situation of the grocery store in Eberly's mills, if Dr. Updegraff didn't?

A. Nobody; I didn't know there was any question about the grocery store until to-day, or until it has been brought out here in question in this room.

X-Q. 263. Do you mean by that the questions that were asked you by Mr. Hill on the witness stand?

A. Yes, sir; I believe he first asked me the question as to its location.

X-Q. 264. Had nobody told you what had been testified to heretofore about the Milltown grocery store?

A. I have no recollection of anyone telling me anything about it.

X-Q. 265. When you and Dr. Updegraff were at Milltown didn't he talk to you about the place where the grocery store was when you and he went fishing there?

A. No, sir.

X-Q. 266. Since you have been here, has nobody talked to you about the testimony that has been given heretofore in the Drawbaugh case?

A. Nobody has talked to me about any testimony that has been given; no, sir.

X-Q. 267. Since you have been here haven't you and Dr. Updegraff and Drawbaugh and Harry Brenizer been together a good deal of your time in a room in this house?

A. I never was in any room in this house with Mr. Drawbaugh except the sitting-room, and then only to pass the compliments of the day. As for Mr. Brenizer, I only met him on the street about a minute and a half as he was coming from his office. I intend to go and see him before I leave the city.

X-Q. 268. Haven't you been spending a good deal of your time with Dr. Updegraff?

A. Yes, sir.

X-Q. 269. What hotel did you and Updegraff stay at at Harrisburg?

A. The first night at the Bolton, the next night and day at the Lochiel.

X-Q. 270. Was Drawbaugh at Eberly's mills when you were there?

A. I didn't see him at Eberly's mills when I was there.

X-Q. 271. Did you see him at Harrisburg?

A. I did.

X-Q. 272. When you and Dr. Updegraff left Cincinnati did you intend to stop at Harrisburg or to come right through to Philadelphia?

A. We didn't intend to stop at Harrisburg; it was my request that we should stop there, simply for pleasure.

Re-direct by Mr. Hill:

Q. 273. Who were your partners in the ozone business, besides Mr. Cappeller and yourself?

A. Frank Raymond and Guy Weber.

Re-cross by Mr. Dickerson:

X-Q. 274. What was the ozone powder made of, which your firm manufactured, and which made the money pour in as long as you advertised it, and which you stopped advertising because you got money enough out of it?

A. I got five thousand dollars for telling a man that once; that was a secret, and still remains a secret.

X-Q. 275. Was it a secret of your discovery?

A. The plan of doing business was my discovery.

JOSEPH M. BOYLE.

Sworn and subscribed to before me this 4th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Adjourned until February 5, 1885, at 10 A. M.

February 5, 1885, 10 A. M.

Examination resumed.

Present: Same counsel.

George F. Stackpole being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is thirty; residence, Lewistown, Pennsylvania; occupation, printer.

Q. 1. What business are you now engaged in?

A. Publishing and editing the Lewistown Gazette.

Q. 2. Did you ever work at Harrisburg, Pennsylvania?

A. Yes, sir.

Q. 3. When did you go to Harrisburg to commence your work there?

A. January, 1875.

Q. 4. Were you a married man at that time?

A. No, sir.

Q. 5. How long did you remain at Harrisburg?

A. Nearly four years, at different periods.

Q. 6. I mean, how long did you remain there, at the time when you went there about January, 1875?

A. Until the fall of 1876.

Q. 7. Where did you board when you first went to Harrisburg?

A. At Wolf's on Market street below Fourth.

Q. 8. Did you board at Wolf's all the time from January, 1875, till the fall of 1876?

A. No, sir.

Q. 9. Where else did you board during that period?

A. At Dr. Updegraff's and Vaughn's.

Q. 10. When did you commence to board at Dr. Updegraff's, and how long did you board with him?

A. From spring until towards fall of 1875.

Q. 11. State whether or not you ever boarded with him at any other time?

A. No, sir.

Q. 12. Will you state, as nearly as you can, at what time in the spring of 1875 you commenced to board with Dr. Updegraff, and how long you continued to board with him?

A. April, I think, and I left there, I think, in September?

Q. 13. In what house was Dr. Updegraff living at the time when you boarded with him?

A. At the corner of Market and Fourth.

Q. 14. Do you know who his landlord was?

A. I understood it to be Mr. Strouse, who kept a hat store under or in front.

Q. 15. Did Dr. Updegraff occupy the remainder of the house, except the lower front rooms?

A. Yes, sir.

Q. 16. Did you room there as well as board?

A. Yes, sir.

Q. 17. Mention the names of any other boarders who lived there while you lived there, so far as you can remember them?

A. Dr. Updegraff's father, mother, Mr. Irvin, Boyle, Goldsmith, McGaffick, Duncan, and I think there was a Brenizer there, also Mr. Jordan and wife—the latter two table boarders.

Q. 18. Did you ever go on any fishing excursions during the time you lived at Harrisburg in 1875?

A. Yes, sir.

Q. 19. And how many during that time?

A. One.

Q. 20. Did anybody go with you, and if so, who?

A. Yes, sir; Messrs. Updegraff, McGaffick, Boyle and Smith.

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Q. 21. Where did the party go on that occasion?

A. To the Yellowbreeches creek, at Milltown, Cumberland county.

Q. 22. How long did you stay over in Cumberland county on that excursion?

A. Parts of two days and one night.

Q. 23. Where did you spend that night?

A. Mainly on an island in the creek at Milltown, I think there is only one there, but am not absolutely certain.

Q. 24. Are you able to fix the date of that excursion?

A. Yes, sir.

Q. 25. How?

A. By an entry in my expense account for a portion of that year.

Q. 26. Have you that expense account here?

A. Yes, sir.

Q. 27. Will you please produce it, and point out the entry to the examiner in order that he may copy it upon the record?

A. Yes, sir; here it is.

Witness produces small pocket diary and points out the following entry: "21, fishing excursion, 40."

Q. 28. What do the figures "21" in that entry indicate?

A. The date of the month.

Q. 29. And what month does the book indicate?

A. June.

Q. 30. In whose handwriting is that entry, and when was it made?

A. In my handwriting, as it was then scratched; I write a back-hand now; then I wrote the other way; it was made in the afternoon or evening, I think of the day of the date, which was the same day we returned from the excursion.

Q. 31. In whose possession has that book been from that time to this?

A. In my possession.

Q. 32. It appears to have been printed as a diary for the year 1874; how do you fix the year of this entry in the book?

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A. It was my custom, for a couple of years, to keep a diary. In 1874, I think, I came into possession of two; having use but for the one, the following year I used the other for 1875, scratching out the day and the "4" in the date, and inserting the proper day and the figure "5."

Q. 33. I notice in this book that the entries in the diary part commence with the first of January, 1875, and end with the second day of February, 1875; did you keep a diary after that?

A. No, sir.

Q. 34. I also notice that in the latter part of the back there are printed and ruled blank pages, in the form usually found in pocket diaries, for a cash account of each month of the year, in which your entries commence on the first day of January, and run along regularly to and including the tenth day of July, where they cease. Do you remember where or how you kept your cash account after July 10, 1875, or why this book contains none after this date?

A. I have no recollection of keeping any personal cash account after that date; I can't say why I ceased to do so.

Mr. Hill requests the examiner to copy upon the record at this point the entries in the witness' said cash account, as contained in the pocket-diary produced by him for the month of June, 1875. They are as follows:

CASH ACCOUNT. JUNE.

Date.			Received.	Paid.
5		Wash,		50
8		Board,		5.00
9		Work,	.20	
12		Suit of clothes,		40.00
12		Hat,		2.25
"		Key,		20
"		Blyth,		50
"		Miscellaneous,		10
13		S. S. & Church,		11
15	Board,			5.00
19		Work,	11.71	
			11.91	

Date.	Cash Account, June.	Paid.
20	Stamps, . . .	24
"	Me, ...	1.00
19	L. B. S. F., . . .	3.00
21	Fishing excursion, . .	40
23	Collars, ...	30
25	Wash, ...	25
	Miscellaneous, . .	20
		59.05
29	Board, ...	5.00
		64.05
		11.91
		52.14

Q. 35. I notice in your cash account in your pocket-diary quite a number of entries generally occurring several days apart, some of which are simply marked "S. S." and some "S. S. & Church;" what do those entries relate to?

A. It was my custom then to attend church at least once on Sunday, and Sunday-school every Sunday; and those figures represent the contributions.

Q. 36. Please examine your diary—I mean the diary entries proper—between January first and February second, and state what day of the month of January the first Sunday in the year occurred?

A. The third.

Q. 37. In your cash account, as shown in said pocket diary, for the months of May and June, I notice that the Sunday-school entries occur on the second, ninth, sixteenth and thirtieth days of May, and the thirteenth day of June; does that fact indicate that those days were Sundays?

A. Yes, sir.

Q. 38. Then the 20th day of June that year was Sunday, which would indicate that your fishing excursion commenced on Sunday; do you recollect about that?

Objected to as leading.

A. No; it wasn't on Sunday, the fishing excursion wasn't on Sunday.

Q. 39. Have you any recollection on what day of the week it was?

A. We must have gone on Monday, and come back on Tuesday; and I suppose I entered this item of account as the expense having all taken place on the 21st, on the following day after our return from the trip, although the time of the entry may have been a day or two later and entered for that day.

Q. 40. Was that the only fishing excursion that you went on that summer?

A. Yes, sir.

Q. 41. Do you remember whether or not any of the other inmates of Dr. Updegraff's house went on any other fishing excursions that summer?

A. Yes, sir.

Q. 42. Who went?

A. Dr. Updegraff and Mr. Boyle were taken up to the Yellowbreeches creek by Mr. Jordan—how far, I don't know; and Dr. Updegraff, if I remember rightly, went up the Susquehanna river in the neighborhood of Rockville, at another time.

Q. 43. Referring to the trip of Dr. Updegraff and Mr. Boyle, when Jordan took them over to the Yellowbreeches; was their trip before, or after your trip?

A. Before.

Q. 44. Do you remember whether or not they took a boat with them on their trip?

A. I didn't see them go or come back, as far as I remember, but I think they took a boat with them.

Q. 45. What kind of a boat?

A. They called it a canvas boat.

Q. 46. Whose was it?

A. I understood it to be the doctor's; he made it.

Q. 47. Did you see the boat after Dr. Updegraff and Boyle came back?

A. It is more than likely I did, but after this lapse of

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time I do not like to be too positive; I saw it while it was being built and afterwards.

Q. 48. Where was it built?

A. At the doctor's house, corner of Fourth and Market.

Q. 49. After Dr. Updegraff and Mr. Boyle returned from their fishing excursion at the time when Mr. Jordan drove them over to the Yellowbreeches, do you remember whether there was any talk at the doctor's house about what they had seen and what they had done on that fishing excursion?

A. They talked over their trip, I remember that, and related their experience.

Q. 50. What is your recollection, so far as it goes, as to what they had seen on that trip, and whether they had seen anything of interest, and as to where they had been while on the trip?

Objected to as asking for guess-work and not for memory.

A. As to where they had been; they put their boat in the creek at some unknown point to me, above Milltown and floated down to that place. I remember of their talking of stopping at some point before they arrived at Milltown, but just at what place—I guess you had better put that—"starting to float, because they didn't float all the way down." At first I understood that Boyle objected to getting into the boat, but finally was persuaded by the doctor to do so. They got along all right, until they struck a riffle, where the boat was injured beyond use. How they got from that point I forget. Some place on the way to Milltown they stopped and visited a party; and I remember of their having some kind of interesting experience there, but am unable to state what. I understood that during a night they stayed at mill, or something of that nature, at Milltown. My impression is, that I heard them talking, in general conversation, at the boarding-house, about something interesting, especially to the doctor, at or in the neighborhood of that place; but just exactly what it was my memory is not so clear; I suppose this is because the doctor,

according to our opinion at the house, was inclined to be a little visionary, and we took his statement sometimes with allowance; and because of this, it did not make the impression on me that it otherwise would have.

Q. 51. Explain what you mean by the doctor's being a little visionary, as you thought?

A. Seeing much where sometimes others saw little.

Q. 52. Untruthful or over-enthusiastic in his opinions?

A. I never heard him charged with being, or had any idea that he was, untruthful.

Q. 53. In your 50th answer you state: "My impression is that I heard them talking in general conversation at the boarding house about something interesting, especially to the doctor, at or in the neighborhood of that place, but just exactly what it was my memory is not so clear." If you have any impression left on your memory as to what it was, will you please state what that impression is?

Last objection repeated.

A. I can't state anything definitely.

Q. 54. When you were on the fishing excursion with Dr. Updegraff, Boyle, McGaffick and Smith, and camped on the island in the Yellowbreeches near Milltown, do you remember whether or not there was an old mill near your camp?

Same objection.

A. There was.

Q. 55. Did you go into that mill during your trip?

A. No, sir.

Q. 56. Did you fish any around the mill?

A. Yes, sir.

Q. 57. Where?

A. I think almost under it—as near as it was possible to get under it.

Q. 58. Do you know whose mill or shop that was?

A. There is no doubt I knew then, but I can't say to-day.

Q. 59. Was your fishing around close to the mill done in the daytime or in the night?

A. I think we rowed by it during the day. I know I

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complish this we had to turn the heavier garments towards the fire as one side dried; this required watching to keep them from burning; the boys continued to grow sick, necessitating our paying some attention to them also; in the morning matters had, of course, improved somewhat; but they were yet sick, especially McGaffick, and the clothes were not yet quite so dry as they should be; Boyle and McGaffick being unable to look after either their clothes or themselves, necessitated looking after them. That is the reason I remained at the island while Updegraff and Smith were absent; and after they returned, and we had got everything ready to leave, we did not have much more than time to make the Cumberland Valley train for Harrisburg.

Recess until 3 P. M.

Q. 72. Was the drinking from that jug, so far as the members of your party were concerned, confined to Boyle and McGaffick, or did you and Smith and Updegraff also partake of it?

A. So far as I saw, nobody but Boyle and McGaffick drank; Updegraff was satisfied with a smell of the contents; I don't think Smith drank any of it; and I know I did not.

Q. 73. You have referred to Dr. Updegraff's father, as boarding with him while you boarded there; was he a physician also?

A. So I understood.

Cross-examined by Mr. Dickerson:

X-Q. 74. Was he the same kind of a physician that Dr. Updegraff was, or another kind?

A. I cannot say.

GEO. F. STACKPOLE.

Sworn and subscribed to before me this fifth day of February, 1885.

FRED M. OTT,
Special Examiner.

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William B. Irwin being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is fifty-five; residence Harrisburg, Pennsylvania; occupation, notary public and general insurance agent.

Q. 1. How long have you resided in Harrisburg?

A. I went to Harrisburg in the year 1863 from Philadelphia.

Q. 2. Where had you resided prior to that?

A. In Cumberland county, Pennsylvania, from my birth to 1862, then the balance of the time in Philadelphia, except the portion of a year when I was in Mexico. It was very nearly 1869 when I went to Harrisburg. It was during the latter portion of the fall of 1869.

Q. 3. Did you ever hold any public office in Cumberland county; if so, what?

A. I was elected to the state house of representatives in the fall of 1860 for the session of 1861.

Q. 4. While residing in Harrisburg, did you ever become acquainted with Dr. C. E. Updegraff?

A. I did.

Q. 5. When did you first become acquainted with him, if you remember?

A. In the spring of 1875—March, I suppose, you may put that.

Q. 6. Did you have any business intercourse with him at that time; if so, what?

A. I made arrangements to board and room at his house at Fourth and Market, Harrisburg.

Q. 7. Where was he living when you made the arrangement?

A. Corner of Fourth and Market in the Bucher property.

Q. 8. When did he move to the corner of Fourth and Market, and how long did he live there?

A. About the first of April, 1875, and lived there one year.

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Q. 9. Where did he move to from that house?

A. He moved up in Fourth street back of the Adams express office; the building was the Young property.

Q. 10. And how long did he live there, so far as you know?

A. From April, 1876, to the first of February, 1877, as near as I can tell; he moved away to Philadelphia before the first of April, a couple of months.

Q. 11. When did you begin to room and board with him?

A. April, 1875, at Fourth and Market.

Q. 12. How long did you continue to board and room with him at Fourth and Market?

A. Until April, 1876, when he moved to the Young property.

Q. 13. While he lived on the Young property, where did you room and board?

A. With him, until he moved to Philadelphia.

Q. 14. Who lived in his family besides yourself when he lived at the corner of Fourth and Market, so far as you remember?

A. Frank McGaffick, Joseph Boyle, Brenizer, I don't know his first name—I have forgotten it if I did—young Stackpole, a printer; the father of the doctor was there part of the time and his mother; there was a stereotyper lived there; I can't recall his name just now; he worked in the state printing building; also William Goldsmith, a printer.

Q. 15. Were you at the Centennial Exposition in 1876?

A. I was.

Q. 16. Do you remember what house you went from and returned to on that trip, or those trips?

A. It was when they lived in the Young property on Fourth street, and from that circumstance I can fix the date of when I lived with him at Fourth and Market—1875.

Q. 17. While you lived with Dr. Updegraff, as you have stated, did you ever know any member of his household to go on any fishing excursions?

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A. I did. Boyle and the doctor went over into Cumberland county on several occasions—perhaps two. A large party, consisting of McGaffick, Stackpole, Boyle—I don't know if there were others—were out on a fishing excursion. They were there parts of two days, I think—didn't return until next day.

Q. 18. Do you know Daniel Drawbaugh, of Eberly's Mills, Cumberland County?

A. I do.

Q. 19. How long have you known him?

A. Personally, only a short time, and then only slightly, not familiarly.

Q. 20. Were you ever in his shop or mill at Eberly's Mills?

A. I was not.

Q. 21. Did you ever hear of his talking machine?

A. I did. On the return of this party from their fishing excursion, Dr. Updegraff and Boyle both had a great deal to say about him—spoke of having talked through his machine; and the matter was quite a subject of conversation in the house for some time; the doctor asserting the wonders of the machine, and was corroborated by Boyle to such an extent that I thought he was playing a joke on us. Not having seen it myself, I had my doubts; but they asserted it with great earnestness.

Q. 22. Do you remember whether they said anything about the distance to which one could talk through the machine; if so, what, so far as you remember?

Objected to as leading and calling for hearsay.

A. They did, and the distance was so great that I had my disbelief, not having any knowledge of anything of the kind at that time.

Q. 23. When and in what house did you hear those conversations of Mr. Boyle and Dr. Updegraff about Mr. Drawbaugh's talking machine?

A. It was in warm weather, about the month of June, 1875, in the house on the corner of Fourth and Market.

Q. 24. And do you remember what rooms in the house the conversation took place in?

A. In the dining-room, at meal times, and in the sitting-room or general meeting room over the store-room. It was used as a sitting-room.

Cross-examination waived by counsel for complainants.

WM. B. IRWIN.

Sworn and subscribed to before me this 5th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Recess until 3 P. M.

John H. Updegraff, being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is thirty four; residence 267 South Third street, Philadelphia; occupation house and sign painter.

Q. 1. Are you a brother of Dr. C. E. Updegraff who was examined as a witness in the telephone case between the Bell company and the Peoples' company?

A. Yes, sir.

Q. 2. Did you ever hear of such a thing as a talking machine anywhere?

Objected to as leading.

A. Yes, sir.

Q. 3. When, where and from whom did you first hear of a talking machine?

A. In 1875, at Harrisburg. On July the 4th I paid a visit there to my brother Dr. C. E. Updegraff who was then living at the corner of Fourth and Market. During my stay there for that day, among other things that were brought up, they were speaking about making a fishing tour, or excursion rather, in a canvas boat that they had made, and coming down the creek or stream they had caught on a

snag and bursted a hole in the boat, and went into a mill, camped over night or slept there. This was in a conversation that was between Boyle and my brother, I think, and myself. And during that conversation they spoke of seeing a talking machine, and when they would go on another fishing excursion they would be able to talk to Philadelphia to me, and they would invite me up, which they said in a joking way.

Q. 4. Did they tell you where they had seen the talking machine; if so, where?

A. In this mill where they camped over night.

Q. 5. How long were you at Harrisburg on that visit to your brother?

A. Parts of two days.

Q. 6. How often did you ever visit your brother at Harrisburg?

A. That is the only visit I ever made to him from this city.

Q. 7. How long have you lived in this city?

A. The last time I moved back here was about the latter part of 1872, or the beginning of 1873, and I have lived here ever since.

Q. 8. Where did your brother Dr. C. E. Updegraff spend most of his time during the Centennial year?

A. With me, here in Philadelphia.

J. H. UPDEGRAFF.

Sworn and subscribed before me this 5th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Complainant's counsel owing to a misunderstanding as to the time, not being present during the direct examination, the witness is recalled for cross-examination.

Feb. 6, 1885, 11 A. M.

John H. Updegraff, cross-examined by Mr. Dickerson:

X-Q. 9. How long have you lived at No. 267 South Third street?

A. Three years the eleventh of this month (February, 1885), that is, my rent began then; I lived there a month previous, while I was fixing the house up.

X-Q. 10. That is, you went there about the first of January, 1882.

A. The eleventh of January, 1882, I went there.

X-Q. 11. Did you board with your brother at any time?

A. No, sir; let me understand the question first. Do you mean here, in Philadelphia?

Question repeated.

A. Fifteen years ago, when I was first married, I went to Scranton, Penna., and stopped with him there a short time, until I went to housekeeping for myself.

X-Q. 12. What was he doing in Scranton at that time?

A. Practicing physician and surgeon, running a hospital.

X-Q. 13. Where did you go from Scranton?

A. To Sunbury, Penna.

X-Q. 14. What sort of a hospital was it that your brother was running in Scranton, and in what year was it?

Objected to as irrelevant and immaterial.

A. To the best of my knowledge the latter part of 1870 or beginning of 1871; it was an eye and ear and general surgery hospital.

X-Q. 15. Where was it situated in Scranton, and describe the hospital?

Same objection.

A. When I first went there, it was on Lackawanna avenue; I don't know as I could describe the building; he next went to Franklin avenue, in a double three-story brick.

X-Q. 16. By what name or title was this hospital known?

Same objection, and also because the question inquires for new matter not referred to in the direct examination.

A. Well, to the best of my knowledge, "Dr. Updegraff's Hospital."

X-Q. 17. Did you live in the hospital.

Same objection.

A. Yes, sir; I had two rooms adjoining in the same building.

X-Q. 18. Were there other persons living in the hospital besides yourself and the patients and Dr. Updegraff?

Same objection.

A. Yes, sir; one family by the name of Washington Roseler—himself, wife and one child.

X-Q. 19. Then it was a kind of a combined boarding-house and hospital, was it?

Same objections.

A. Well, that I couldn't say positively; he did board some of his patients that had to be there for treatment.

X-Q. 20. Were you an assistant of his at that time.

Same objections.

A. No, sir.

X-Q. 21. When you visited him in Harrisburg, was he keeping a hospital, a boarding-house, or a combined hospital and boarding-house?

A. Well, first I would like to know if, upon the visit from Philadelphia that I made July 4th, 1875, he was living at Fourth and Market; he was only keeping a boarding-house at that time, to the best of my knowledge.

X-Q. 22. What is it you would like to know?

A. If I ever stopped there previous to that.

X-Q. 23. Don't you know; and if you do, why do you ask me whether you did or not?

A. For information; I stopped there once for two days, when I moved back to Philadelphia in the latter part of 1872 or the beginning of 1873.

X-Q. 24. Who were boarding with him July 4th, 1875?

A. Joseph Boyle, Frank McGaffick, William Goldsmith, Mr. Stackpole, Mr. Irwin, Mr. Jordan, wife and child, my father and mother; that is about all I remember.

X-Q. 25. Did you make the acquaintance of these board-

ers, except your father and mother, then for the first time?

A. Yes, sir.

X-Q. 26. And you now remember that their names were Joseph Boyle, Frank McGaffick, William Goldsmith, Mr. Stackpole, Mr. Irwin and Mr. Jordan?

A. Yes, sir.

X-Q. 27. Did they tell you at that time that their names were respectively Joseph, Frank and William?

A. I could not say as they did call their first names at that time, when they were introduced to me, but I have met them so frequently since that I have become accustomed to calling them by their first names.

X-Q. 28. Where and when have you been in those intimate relations with these men?

A. In the first place, with Mr. Goldsmith being working here in the city, being back and forward since that time; with Mr. Boyle being in business with my brother at one time, on Third street, where I was a frequent visitor, he only being two or three doors from me.

X-Q. 29. That is, you lived at No. 267 South Third street and they lived at Nos. 263 and 5?

A. The numbers are not the same now as then; there were two buildings between us.

X-Q. 30. Your brother still lives in that same place, doesn't he?

A. No, sir.

X-Q. 31. Where does he live?

A. 1914 Mount Vernon street.

X-Q. 32. When did he leave the South Third street house?

A. I don't know as I could say the exact time—within a year; I don't know as he has been away a year.

X-Q. 33. What business is he carrying on now?

A. A skating rink at Broad and Spring Garden; he is interested in it.

X-Q. 34. Did he live at any other house at South Third street than the one No. 267, near which you lived, so far as you know?

A. No, sir.

X-Q. 35. Who told you, before you were called as a witness here, that these different men boarded with your brother in 1875, at Harrisburg?

Objected to as assuming and entirely unwarranted by anything in the testimony of this witness or any other witness in this case.

A. Nobody, to my recollection.

X-Q. 36. Who told you about the conversation that you heard about July 4th, 1875?

Same objection.

A. Between Mr. Boyle, William Goldsmith, McGaffick, my brother and myself.

X-Q. 37. When did they tell you, that you heard that conversation in 1875?

Same objection.

A. About July 4th, 1875, when I was there on a visit, and spent a part of two days.

X-Q. 38. Haven't they or any of them told you about it since?

A. Yes, sir; I have heard them speak of it, not direct to me; I have heard them speak of it in conversation with others.

X-Q. 39. Then they didn't tell you directly, they told it in your presence?

A. Told what?

X-Q. 40. Told what was said July 4th, 1875, when you were at Harrisburg?

A. No, sir; not since.

X-Q. 41. What was it they did tell in your presence, if it was not that conversation?

A. Well, so many conversations and talks of it that I have heard since that time, that it would be impossible for me to commit them to memory.

X-Q. 42. But you are sure, are you, that in those numerous conversations on that subject, they didn't tell you, either directly or in your presence, about the conversation which you heard July 4th, 1875, and to which you have testified here?

A. Not word for word—I couldn't say.

X-Q. 43. Didn't they tell you that, in substance, they had said such things, when you were present in 1875?

A. There might have been some words, probably. It was so mixed up, and so much of it, that I wouldn't like to say one way or the other.

X-Q. 44. When was it that the conversation occurred in which there was so much of it, and so mixed up, that you wouldn't like to say what it was?

A. In the Washington Hotel, within the last week or so—the boys sitting there and talking, joking and laughing over it.

X-Q. 45. Name the boys who were in the Washington hotel within the last week or so joking and laughing over what occurred and what was said at Harrisburg in July, 1875.

A. I didn't say that. Well, Boyle, McGaffick, Stackpole, Goldsmith, myself, and I think, probably, my brother might have been there on a few occasions; it sometimes took place between two or three of us—sometimes, maybe, more—talking about fun, and so forth.

X-Q. 46. Have you named all the boys that have been assembling at the Washington hotel for the last week or so, laughing and joking over this business? Haven't you accidentally omitted Drawbaugh from the party?

Objected to as assuming, particularly in view of the last answer.

A. I would like to answer that in three parts—as three different questions; I haven't named all the boys there; the rest of them didn't joke, to my knowledge; the joking wasn't done about Drawbaugh or his machine. It was about the boys' experience while on that trip. I haven't accidentally omitted Drawbaugh from the party. I never spoke to him only on one or two occasions, and then merely to pass the time of day. I never knew him to mix with anybody around the hotel there, more than to bid them the time of day, to my knowledge.

X-Q. 47. Hasn't Harry Brenizer been there with the other boys?

A. No, sir; not to my knowledge.

X-Q. 48. Can't you remember anything that has been said about the conversation of July 4th, 1875, during this week or so among the boys at the Washington hotel?

A. I believe I answered that question.

X-Q. 49. Did you answer that you could remember, or that you couldn't remember?

A. I said that I—there might have been some words of it, there was so much said of it—there might have been some of the words, I would not like to say positively.

X-Q. 50. State, as nearly as you can remember, what was said in your presence, when the boys were assembled at the Washington hotel, about the conversation of July 4th, 1875, and who it was that said it?

Objected to because the witness has already fully testified upon this point.

A. I can't say that there was anything particular as to the 4th of July said, I did not know they went fishing on the 4th of July, 1875.

X-Q. 51. What was said at the Washington hotel, as near you can remember, about the conversation which occurred in your brother's boarding-house in Harrisburg, when you were there in 1875; and which of the boys said it, as nearly as you can recollect?

Same objection.

A. I can't say, they were talking about his boarding-house or the conversation that took place there. I didn't state anything of that kind; these conversations was about themselves; their experiences on their trips, what they went through.

X-Q. 52. Did Boyle tell about how he got drunk on one of those trips?

Objected to as immaterial and irrelevent.

A. No, sir; not to me.

X-Q. 53. During the last two weeks, since you have been associating with your brother and the other boys, at the Washington hotel, has nobody said in your presence, that when you were in Harrisburg in 1875, the conversation

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which you have sworn to in this examination occurred in Harrisburg and in your presence?

A. No, sir; not to my knowledge.

X-Q. 54. Then the first time that that conversation has been spoken of in your presence, so far as you at present recollect, for the last two weeks, was when you swore to it here last night?

A. Yes, sir.

X-Q. 55. Can you tell us what Boyle said, exactly, in 1875, when you heard that conversation, in respect to the talking machine?

A. No, sir.

X-Q. 56. Did he tell you how far the men were apart when he talked through it?

A. No, sir; he never told me he talked through it, to my recollection.

X-Q. 57. Where did you live before you moved to No. 267 South Third street?

A. At 215 Pine street.

J. M. UPDEGRAFF.

Sworn and subscribed to before me this 6th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Wm. A. Goldsmith being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is thirty-four years; residence, Philadelphia, Penn.; occupation, compositor.

Q. 1. Did you ever live in Harrisburg, Penn.?

A. Yes, sir.

Q. 2. Did you know Dr. C. E. Updegraff there?

A. I did.

Q. 3. Did you ever at any time board in his family?

A. Yes, sir.

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Q. 4. When?

A. I first went to board with him, I don't know whether it was April, but it was quite early in the spring of 1875.

Q. 5. How long did you board with him?

A. From this time of which I speak until the spring of 1877.

Q. 6. Where was Dr. Updegraff the most of the time during the year 1876?

A. In the city of Philadelphia.

Q. 7. In what house was he living at the time when you first went to board with him?

A. He was living in Mr. Strouse's house at the corner of Fourth and Market.

Q. 8. And up to what time did he continue to live in that house?

A. Until the spring of 1876.

Q. 9. What house did he move his family into then?

A. He moved into the first small frame house on the other side of the Adams express office, on Fourth street.

Q. 10. During the time that you boarded with him in the house at the corner of Fourth and Market, what other persons, if any, boarded with you?

A. Mr. Boyle, Mr. McGaffick, Mr. Brenizer, Mr. Irwin, Mr. Stackpole, Mr. Duncan, and Mr. and Mrs. Jordan.

Q. 11. Did you ever at any time in your life, hear of such a thing as a talking-machine?

Objected to as leading.

A. Yes, sir.

Q. 12. Can you tell us when and where you first heard of it, and from whom you first heard of it, and how you happened to hear of it?

A. At Dr Updegraff's house on the corner of Fourth and Market, from a party of the boarders who had been on a fishing excursion. It was some time in the spring of 1875. When they returned home they were relating some of the fun they had and what they saw and did, and among other things they were talking of this machine; we were laughing at the doctor at being so much taken with the talking-ma-

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chine, that he saw over there; and he thought this machine was—or could be—a big thing. He was very much interested in it; I laughed at him for taking such an interest in it; I didn't think there was as much in it as he claimed. I can't call to memory, of course, everything that was said, or very much at all about it. He said he had talked in it, and laughingly said he believed you could talk in it or holler in it across the ocean. And on another occasion, when his brother John was visiting his house, in telling him of this machine, they said that when they wanted him to go on another fishing excursion, they would just holler over to Philadelphia for him. I wouldn't pretend to remember anything further that was said about the machine.

Q. 13. Were you present, when they made the remark to your brother John that you have spoken of?

A. I was.

Q. 14. Where were they when they made that remark to John?

A. They were on the porch, I think, of the house on the corner of Fourth and Market streets; I am not sure about the porch, but I am sure that it was at that house.

Q. 15. You say "they" were talking to John; whom do you mean by "they?"

A. The boarders.

Q. 16. Do you know whether any of the boarders, besides Dr. Updegraff, had seen the talking-machine, so far as you could learn from their conversation at the time?

Objected to as asking for inference and guesswork.

A. One, that I know of, Mr. Boyle.

Q. 17. Did they say where they had seen it?

A. Yes, sir; they said it was over at some mill. I think they said they had been sleeping in the mill during the night of this fishing excursion.

Q. 18. Did they describe the machine; if so, do you recollect the description?

A. They described the machine, but I do not remember the description.

W. A. GOLDSMITH.

Sworn and subscribed before me this 5th day of Feb., 1885.

FRED. M. OTT,
Special Examiner.

Adjourned until Friday, Feb. 6, 1885, at half-past twelve noon, at which time respondent's counsel notified complainant's counsel that he will meet them at this room and proceed with them and their experts, if they shall be present to a convenient place, and there exhibit to them the reproduced instruments referred to in Professor Barker's deposition in this case, and test said instruments in their presence, after which the taking of testimony will be resumed.

Adjourned to the Washington hotel, rooms 27 and 29, before mentioned, in order to see tests of reproduced instruments mentioned in deposition of Professor Barker.

Feb. 6, 1885, 9 P. M.

Present: Mr. Storrow for complainants, and Mr. Hill and Mr. Jacobs for respondents.

Opportunity is now offered to complainant's counsel to cross-examine William A. Goldsmith, at whose direct examination they were not present, owing to a mistake as to time.

Cross-examination waived by Mr. Storrow.

Adjourned to meet at the office of Mr. Fred. M. Ott, Special Examiner, room 9, Trust Building, Harrisburg, Pennsylvania, on Monday, February 9th, 1885, at 10 A. M.

February 9th, 1885, 10 A. M.

Examination resumed at Harrisburg.

Present: Mr. Storrow for complainants, and Mr. Hill and Mr. Jacobs for respondents.

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Benjamin Strouse, being produced, affirmed and examined, saith:

Examined by Mr. Hill:

My age is forty-eight; residence Harrisburg, Penna.; occupation, merchant.

Q. 1. Where is your place of business?

A. Corner of Fourth and Market.

Q. 2. How long have you occupied that corner?

A. I first commenced business there in 1864.

Q. 3. Do you know Dr. C. E. Updegraff, now of Philadelphia, but formerly of Harrisburg?

A. Yes, sir.

Q. 4. Did he ever rent a tenement from you, and live in it?

A. Yes, sir.

Q. 5. In what building was that tenement which he rented from you?

A. The corner of Fourth and Market—the private dwelling part of my place of business.

Q. 6. Will you please look at the memorandum book which I now show you, and at the four pages to which I particularly call your attention, and state whether you know whose handwriting the entries on those four pages are in, and if so, whose?

A. My handwriting.

Q. 7. Will you state when these entries were made in this book?

A. They were made in 1875.

Q. 8. These entries commence with the receipt of rent by you on the 6th of April, 1875, for the month of April 1875, and end with the receipt of rent on the 25th of March, 1876, in full up to April 1st, 1876. Do you know where Dr. Updegraff moved to when he moved out of your house?

A. Yes, sir.

Q. 9. Where?

A. On Fourth street.

Q. 10. Into whose house?

A. Mr. Young's house; at that time, at least, he owned it?

Q. 11. How near was Mr. Young's house to the Adams express office?

A. Either the second or third house, as near as I remember now.

Q. 12. After Dr. Updegraff moved from the corner of Fourth and Market into Mr. Young's house, did he ever rent a dwelling from you again or not?

A. He did not.

Mr. Hill requests the examiner to mark for identification the memorandum book referred to by the witness, and to designate the four pages by him referred to, as Strouse 1, Strouse 2, Strouse 3, and Strouse 4, respectively: the examiner does so. By consent, copies of the same are put in evidence instead of the originals, which are to be produced when called for; the copies to be subject to all legal objections that might be made to the original. Said copies are as follows:

(Strouse 1.)

Received, Harrisburg, April 6th, 1875, of Mr. C. E. Updegraff, twenty-eight dollars rent for house on cor. 4th & Market Sts. up to May 1st and for month of April, 1875.

Duplicate. B. STROUSE.

Rec'd, Harrisburg, May 8th, 1875, of C. E. Updegraff, twenty-eight dollars rent for the month of May, 1875.

B. STROUSE.

(Strouse 2.)

Rec'd, Harrisburg, May 29th, 1875, of Dr. C. E. Updegraff, twenty-eight dollars rent for the month of June, 1875.

B. STROUSE.

Rec'd, Harrisburg, July 17, '75, of Dr. C. E. Updegraff, twenty-eight dollars rent for the month of July, 1875.

B. STROUSE.

(Strouse 3.)

Rec'd, Harrisburg, Sept. 4th, 1875, of C. E. Updegraff, twenty-eight dollars rent for the month of August, 1875.

B. STROUSE.

Rec'd, Harrisburg, Oct. 9th, 1875, of C. E. Updegraff, twenty-eight dollars rent for the month of September, 1875.

B. STROUSE.

(Strouse 4.)

Rec'd, Harrisburg, Nov. 20th, 1875, of C. E. Updegraff, twenty-eight dollars rent for the month of October, 1875.

B. STROUSE.

Rec'd, Harrisburg, Dec. 27th, 1875, of C. E. Updegraff, twenty-eight dollars rent for the month of November, 1875.

B. STROUSE.

Rec'd, Harrisburg, March 25th, 1876, of C. E. Updegraff, one hundred and twelve dollars, being rent in full up to April 1st, 1876.

B. STROUSE.

Q. 13. Do you remember anything about Dr. Updegraff's building a canvas boat while he resided at Fourth and Market streets?

A. Yes, sir.

Q. 14. Where was the boat built?

A. He was fixing at it in the yard, principally, when I seen him.

Cross-examined by Mr. Storrow:

X-Q. 15. At the corner of what streets is the Adams express company?

A. Corner of Fourth and Market.

X-Q. 16. Who brought you this book lately?

A. The book is not in my possession at all; Mr. Updegraff showed it to me lately.

X-Q. 17. When and where did he show it to you?

A. At my store, about two weeks ago, I think.

X-Q. 18. And the book belongs to Dr. Updegraff, does it?

A. I should think so.

X-Q. 19. When did you first let him the property for which these receipts show the rent?

A. In 1875.

X-Q. 20. Who had hired that property from you before Dr. Updegraff hired it from you in 1875?

A. No one, that I can remember; I had been living in it myself, for a while.

X-Q. 21. Do you know where Dr. Updegraff lived before he hired that property from you?

A. No, sir.

X-Q. 22. Do you know Ellen Bucher?

A. No, sir.

X-Q. 23. I find in this book the first receipt in it to be as follows: "Received, Harrisburg, April first, 1874, of Dr. C. E. Updegraff, sixteen dollars rent for rooms on the second floor on the corner of Fourth and Market streets for April, $16.00. Ellen J. Bucher." Was that the same property which you let to Dr. Updegraff?

Objected to on the ground that the entries in the book show that it was not the same property; the properties being at the corners of different streets; one property being at the corner of Fourth and Market and the other at the corner of Front and Market.

A. No, sir.

X-Q. 24. Did you know Dr. Updegraff before he hired from you the property at the corner of Fourth and Market?

A. I did not know him, but had seen him before.

X-Q. 25. When Dr. Updegraff came to your store about two weeks ago, and showed you this book, who was with him?

A. Some gentleman who was a stranger to me; did not know him.

X-Q. 26. Do you know what that gentleman's name was?

A. No, sir.

X-Q. 27. Have you seen him since?

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A. Yes, sir.

X-Q. 28. Where have you seen him?

A. I seen him yesterday on Market street.

X-Q. 29. Do you remember what day of the week it was, that Dr. Updegraff came to you and showed you this book?

A. I do not remember the day exactly.

B. STROUSE.

Affirmed and subscribed to before me this 9th day of February, 1865.

FRED. M. OTT, Examiner.

John Young being produced, affirmed and examined, saith:

Examined by Mr. Hill:

My age is seventy-eight; residence 508 Walnut street, Harrisburg; I have resided in this city since 1811; I have followed an occupation for sixteen years. I followed butchering forty-six years and a half in this city.

Q. 1. Do you know Dr. C. E. Updegraff, who formerly resided in this city and now resides in Philadelphia?

A. Yes, sir.

Q. 2. Did you ever rent him any property?

A. Yes, sir.

Q. 3. What property?

A. I rented him a house at No. 6 Fourth street, near Adams express office in this city.

Q. 4. What use did he make of that house while he resided there?

A. He had it for a private residence; and then he had the front room for a doctor's office; he operated a good deal on the eyes and ears, or was it ears,—eyes I think.

Q. 5. Where did he live last before he rented that house from you?

A. He lived in Mr. Strouse's house, that is diagonally across the street from Adams' express office.

Q. 6. Strouse's house is on the south side of Market street, and Adams' express office is on the north side; is it not?

A. Yes, sir.

Q. 7. And they are also on opposite sides of Fourth street; are they?

A. Yes, sir; Strouse's house is on the east side of Fourth street, and Adams express office on the west side.

Q. 8. Please look at the rent receipt memorandum book now shown you, and particularly at six pages thereof, which the examiner will mark "Young 1, Young 2, Young 3, Young 4, Young 5, Young 6," respectively, and state in whose handwriting the body of each receipt is, if you know, and in whose handwriting the signature to each receipt is, if you know?

A. I can't tell whose the body of it is, but I think it is Clarence Updegraff's—but it is my signature in each of these cases.

Q. 9. By Clarence Updegraff, you mean the man whom we call Dr. C. E. Updegraff, do you?

A. Yes, sir; I remember him writing some of them, if not all of them; I think he wrote all of them, but my memory is not so good as it used to be, and I cannot remember without having it in black and white. I think he wrote part of them, if not all of them.

Q. 10. When did you sign these rent receipts in this book that bear your signature?

A. I always signed them on the days he paid me the money for them: I guess on the same days that they were wrote he paid me the money for them and I signed them.

Q. 11. Do you know where Dr. Updegraff moved to when he left your house?

A. He moved to Philadelphia; I can't tell whereabouts, though, in Philadelphia.

By consent the following copies of said pages are put in evidence instead of the originals; the origin-

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als to be produced when called for, and said copies to be subject to all legal objections that might be made to the originals.

The copies are as follows:

(Young 1.)

Harrisburg, April, 1876.

Received of Dr. C. E. Updegraff eighteen dollars in full for rent for month of April, 1876.

$18.00 JOHN YOUNG.

Harrisburg, May 2, 1876.

Received of Dr. C. E. Updegraff eighteen dollars in full for rent for month of May. - - - - - $18.00

JOHN YOUNG.

(Young 2.)

Harrisburg, June 12, 1876.

Received of Dr. C. E. Updegraff eighteen dollars in full for rent for month of June. - - - - - $18.00

JOHN YOUNG.

Harrisburg, Sept., 1876.

Received of Dr. C. E. Updegraff eighteen dollars in full for rent for month of July. - - - - - $18.00

July. JOHN YOUNG.

(Young 3.)

Harrisburg, Sept. 15, 1876.

Received of Dr. C. E. Updegraff eighteen dollars in full for rent for month of August. - - - - - $18.00

JOHN YOUNG.

Harrisburg, Octr. 30th, 1876.

Received of Dr. C. E. Updegraff eighteen dollars in full for rent for month of September. - - - $18.00

JOHN YOUNG.

(Young 4.)

Harrisburg, Jan. 29, 1877.

Received of Dr. C. E. Updegraff eighteen dollars in full for rent for month of October. - - - - - $18.00

JOHN YOUNG.

Harrisburg, Feb. 1, 1877.

Received of Dr. Updegraff eighteen dollars in full for rent for month of November. - - - - $18.00

JOHN YOUNG.

(Young 5.)

Harrisburg, Feb. 10, 1877.

Received of Dr. Updegraff eighteen dollars in full for rent for month of December. - - - - $18.00

JOHN YOUNG.

Harrisburg, Feb. 10, 1877.

Received of Dr. Updegraff eighteen dollars in full for rent for month of January. - - - - $18.00

JOHN YOUNG.

(Young 6.)

Harrisburg, Feb. 29, 1877.

Rec'd of Dr. C. E. Updegraff eighteen dollars in full for rent to date. - - - - - - - $18.00

JOHN YOUNG.

Q. 12. What building do these rent receipts that bear your signature relate to?

A. They relate to the house No. 6 Fourth street; I rented it from a young girl, and I paid her the rent, and took her receipt for it; I never rented Dr. Updegraff any other property but that.

Q. 13. How long did Dr. Updegraff live in your house?

A. About ten or eleven months; he rented it until the first of April, but he only occupied it from the first of April, 1876, until the latter part of January, 1877—not quite a year, any way.

The book above referred to is the same memorandum book referred to in the deposition of the preceding witness, Benjamin Strouse.

Cross-examined by Mr. Storrow:

X-Q. 14. Have you seen Dr. Updegraff today?

A. Yes, sir.

X-Q. 15. Where have you seen him today?

A. He came out to my house with a sleigh to bring me here; I am not fit to walk out now, and especially such weather as this.

X-Q. 16. You mean to your house here in Harrisburg, I suppose?

A. Yes, sir; where I live, 508 Walnut street.

X-Q. 17. Did you see him last week?

A. Yes, sir.

X-Q. 18. Where?

A. He came to my house last week, to see whether I would be able to come out here if I was called on.

X-Q. 19. Did you see him week before last?

A. He was there twice, I don't know whether the first time was last week or week before last; maybe it was week before last. The first time he came he had just come up from Philadelphia the night before.

X-Q. 20. You have been in a very feeble condition physically for two or three years past; have you not?

A. Yes, sir; for three years.

JOHN YOUNG.

Sworn and subscribed to before me this 9th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Recess until 2 P. M.

February 9th, 1885, 2.30 P. M.

George F. Weaver, Jun., being produced, affirmed and examined, saith:

Examined by Mr. Jacobs:

My age is 45; residence, 203 South River Avenue, Harrisburg, Pa.; occupation, printer.

Q. 1. Have you any official connection with a lodge of Odd Fellows in the city of Harrisburg?

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A. Yes, sir; I am secretary of Dauphin lodge, No. 160, Independent Order of Odd Fellows.

Q. 2. Have you at any time been acquainted with Joseph M. Boyle, a printer, who formerly resided in Harrisburg?

A. Yes, sir.

Q. 3. Will you state whether at any time he belonged to the Lodge of Odd Fellows which you have mentioned?

A. Yes, sir; he did, and is still a member of the lodge.

Q. 4. Did he ever at any time draw sick benefits from that lodge?

A. He did.

Q. 5. If you have present with you the records of the lodge, showing that fact, will you please produce them and read to the examiner, in order that he may copy them upon the record in this case, such entries as you may find relating to the payment of sick benefits to Boyle?

A. I have here now the minute book of Dauphin lodge, No. 160, beginning Oct. 3, 1872, and ending March 25, 1880. In the minutes of June 3d, 1875, J. M. Boyle was reported sick since the first of June, 1875. In the minutes of June 10, 1875, he is reported as still sick. In the minutes of June 17, 1875, he is reported as still sick. In the minutes of June 24, 1875, he was reported as still sick. On July 1, 1875, he was reported off the sick list since the 25th of June, 1875. On June 10, 1875, he drew one week's benefits, five dollars; on June 17, 1875, he drew one week's benefits, five dollars; on June 24, 1875, he drew one week's benefits, five dollars.

I have examined the minute book carefully and have not been able to find any other mention of his having been sick. I have been a member of the lodge from the time J. M. Boyle became a member until the present time, and have no recollection of Boyle having drawn benefits at any other time than the times mentioned; the minute book is entirely in my handwriting. I have examined the minute book for a couple of years prior to 1875, and up to April, 1876.

(Witness continues his examination of minute book.)

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Now I have examined the book up to and including the 2nd of January, 1879, and cannot find any other record of his sickness. I have been almost constantly in attendance at the meetings, except in case of sickness, which was very seldom.

Cross-examination waived by Mr. Storrow.

GEO. F. WEAVER.

Sworn and subscribed to before me this 9th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Adjourned to No. 215 South Front street, Harrisburg.

Hon. Richard J. Haldeman, being produced, affirmed and examined, saith:

Examined by Mr. Hill:

My age is about fifty-three; residence for the present at No. 215 South Front street, Harrisburg, Penna., although I am legally a resident of East Pennsboro township, Cumberland county; occupation, farmer.

Q. 1. Were you formerly a representative in Congress from one of the Pennsylvania districts?

A. I was.

Q. 2. For how many terms?

A. Two.

Q. 3. Do you remember when your official term as representative began?

A. That has been the difficulty hitherto; I think it was 1869, 1870, 1871 and 1872; I was elected in the fall of 1868 and served two terms consecutively—elected in the fall of one year and took my seat the 4th of March in the next; my last term may have run to March 4, 1873.

Q. 4. Did you commence to serve as member of Congress at the same time when General Grant began his first term as President?

A. Let me see a minute; I remember seeing General Grant inaugurated; I was member of Congress at the time. No; I was elected during the term of Andrew Johnson; I may have been elected then, but took my seat afterwards; and I remember, also, going out with the House of Representatives to see Grant take his oath; I was a member of Congress when Grant took his place.

Q. 5. Was Cumberland county in your congressional district?

A. It was.

Q. 6. Did you personally canvass Cumberland county for your nomination or election?

Objected to as leading.

A. I did.

Q. 7. Do you know Daniel Drawbaugh, of Eberly's Mills?

A. I do.

Q. 8. Were you ever at his shop at Eberly's Mills?

A. I was.

Q. 9. What business were you engaged in at the time you first went there?

A. Political—especially to see his brother who was an important man in Cumberland county politics; I believe he gave me his name to-day—Henry A. Drawbaugh or Henry Drawbaugh; I asked the name from Daniel to-day, and I believe that is what he gave as the name.

Q. 10. You say that at the time when you were first at Daniel Drawbaugh's shop, you were engaged on political business; what particular political business?

A. A candidate for Congress.

Q. 11. Do you remember whether that was before, or after your first election to Congress?

A. It was during my first canvass and previous to my election.

Q. 12. Will you tell us what took place in Mr. Drawbaugh's shop on that first occasion when you visited it during your first canvass and previous to your election?

A. He took me to his shop and showed me his working tools, and showed me also a communication which he had established with a neighboring house or barn with something that led from his window—from a window of his working-shop; I was so much impressed that invariably, when elected to Congress—after a severe struggle—I sent to Daniel Drawbaugh the mechanical reports, believing him to be a mechanical genius.

Q. 13. Do you remember what he called that contrivance which he showed you for communicating from one point to another?

A. They called it in the country around there, a speaking machine. I don't know that he gave it a name.

Q. 14. Did he make to you at that time any exhibition of its method of operation?

A. I think he did, but I am not able to answer. I was convinced of its working, but I should be afraid to answer that. He showed me and convinced me, without my saying how.

Q. 15. In what way was this apparatus designed to communicate, and what was it to communicate?

A. By sound; or, if you wish to make it more particular, by articulate speech.

Q. 16. Do you remember by what means the articulate speech was communicated by this machine?

A. By running along his cotton string; he had a string reaching out from his window, and the string, I believe, enveloped a metallic wire; but that I don't know.

Q. 17. Did he say how the voice in speaking acted upon the air?

A. By vibrations.

Cross-examined by Mr. Storrow:

X-Q. 18. When you left Congress where did you go to live?

A. My legal home then, and now, is in East Pennsboro township, Cumberland county.

X-Q. 19. Where did you go to reside when you left Congress?

A. To my home in East Pennsboro, Cumberland county, Penna.

X-Q. 20. Did you own the house you then went to live in?

Objected to as immaterial and irrelevant.

A. I did, and still do?

X-Q. 21. Where have you lived ever since?

A. In Harrisburg, but my legal residence is on the other side of the river.

X-Q. 22. What houses have you lived in in Harrisburg?

A. Two; one adjoining my mother, on Front street,

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where my father's office was, and the other, Larue Lemer's house, where we are now.

X-Q. 23. How long have you occupied the house where we are now?

A. That is pretty hard to answer; when you get to a question of dates, you bother me; I think it is two years, but I am not positive; it may be three or four.

X-Q. 24. What house in Harrisburg did you occupy before you moved to where we are now?

A. The house next to my mother's at Walnut and Front, built by Mr. Hill, the architect of the State capitol.

X-Q. 25. How long did you occupy the house?

A. There you come at dates again; that bothers me; for some years, I only lived there in winter, and went away in summer; I am not a chronological dictionary.

X-Q. 26. What have been your occupations since you left Congress?

A. Well, I answer you as I did in Congress; farmer.

X-Q. 27. A farmer with a house in Harrisburg; is that what you mean?

A. No, I don't own a house in Harrisburg—with a residence in Harrisburg, you may say; but my legal home is in Cumberland county.

X-Q. 28. Has your health been feeble, for some time past?

A. I feel able to fight; I'm not strong, but able to fight.

X-Q. 29. Since you left Congress what have been your occupations?

A. Looking after estates that reach from Minnesota to three counties in Pennsylvania; I have forty-three acres in the city of St. Paul, Minnesota—that is, I did have, but it is now being laid out in town lots and sold; I have property in three wards in Harrisburg.

R. J. HALDEMAN.

Affirmed and subscribed to before me this 9th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Richard J. Haldeman re-called.

Examined by Mr. Hill:

Q. 30. Have you ever been in Mr. Drawbaugh's shop since you left Congress?

A. That is very difficult to answer; I may have been, and may not; I have been at Eberly's Mills; I have been in the shop and village several times; I went to see the Drawbaughs with reference to the measuring faucet which Daniel Drawbaugh invented.

R. J. HALDEMAN.

Affirmed and subscribed to before me this 9th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Margaretta C. Haldeman, being produced, affirmed and examined, saith:

Examined by Mr. Hill:

I am the wife of Richard J. Haldeman, the witness whose deposition has just been taken.

Q. 1. Are you a daughter of Gen. Simon Cameron, formerly Secretary of War?

A. I am, sir.

Q. 2. When were you married to Mr. Haldeman.

A. In May, 1870.

Q. 3. What was Mr. Haldeman doing in the summer and fall of 1870?

A. He was going through Cumberland county, electioneering.

Q. 4. Electioneering for himself or some other person?

A. Himself.

Q. 5. For what office?

A. Congressman.

Q. 6. Was that for his first or second term in Congress?

A. His second term.

Q. 7. Did you accompany him all through his electioneering trips that summer and fall?

A. I did, through the whole.

Q. 8. When and where did you first hear of Daniel Drawbaugh of Eberly's Mills?

A. It was during that summer through Cumberland county; I couldn't tell the exact dates.

Q. 9. What did you hear about him that summer?

Objected to as calling for hearsay.

A. Mr. Haldeman spoke to me as we were driving through Cumberland county, and said that Mr. Drawbaugh had made some kind of an instrument to talk through.

Q. 10. Did he tell you how he knew about it?

Same objection.

A. He had been there in canvassing the county before, and saw this machine or instrument.

Q. 11. Did he tell you what canvass he had seen it upon?

Same objection.

A. The congressional canvass before, the former one.

Q. 12. Did he tell you whether the machine was operated in his presence, or not, when he saw it?

Same objection.

A. I understood that it was.

Q. 13. And what did you then understand that that machine would do?

Same objection.

A. Why, it would carry the voice from one place to another.

Q. 14. And by what means would it carry the voice from one place to another, as you then understood?

Same objection.

A. By electricity.

Q. 15. Did you, or did you not, hear any talk from others in Cumberland county that summer about Mr. Drawbaugh's said invention?

Same objection.

A. Yes; I did.

Q. 16. To what extent did you hear it talked about

among the people in Cumberland county there that summer, and what did they say about it?

Same objection.

A. There was a good deal of talk there, and it was spoken of as Drawbaugh's talking-machine, and an improvement on the telegraph.

Q. 17. When you first heard of the Bell telephone, did you or your husband make any remark about it; and if so, what?

Same objection.

A. Mr. Haldeman did, saying that it was Drawbaugh's patent, or rather, Drawbaugh's invention; I think that was the word he used.

Q. 18. When were you first spoken to about your knowledge of this matter?

A. To-day, if you mean by anybody outside of my own family.

MARGARETTA C. HALDEMAN.

Affirmed and subscribed to before me this 9th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Adjourned until Feb. 10, 1885, at 10 A. M.

February 10th, 1885, 10 A. M.

Examination resumed.

Present: Same counsel.

Elias Hake, being produced, sworn and examined, saith:

Examined by Mr. Jacobs:

My age is fifty-eight years; residence, Fairview township, York county, Penna., on the other side of the Yellow-breeches creek from Eberly's Mills; occupation, farmer.

Q. 1. Do you own a mill over in Cumberland county?

A. Yes, sir.

Q. 2. Please state where it is located?

A. In Lower Allen township, Cumberland county, on the Yellowbreeches creek.

Q. 3. How far is it from Eberly's Mills or Milltown?

A. It is about one mile, as near as I can tell.

Q. 4. Is it above, or below Eberly's Mills, by the creek?

A. It is up stream from there.

Q. 5. Did you ever rent that mill to John J. Zacharias?

A. Yes, sir.

Q. 6. When?

A. In the spring of 1875—I think is the time.

Q. 7. Did you have a written lease of it with him?

A. Yes, sir; I had.

Q. 8. If you have that lease with you, will you please produce it?

A. Yes, sir; here it is.

Q. 9. By whom is the lease signed?

A. It is signed by myself and Mr. Zacharias.

Q. 10. It appears to have been witnessed by Simon Horst; is he living or dead?

A. He is dead.

By consent a copy of said lease is put in evidence instead of the original; the original to be produced when called for, and said copy to be subject to all legal objections that might be made to the original.

The copy is as follows:

Hake—Zacharias. Grist-mill. Lease No. 1.

This indenture, made this day of March, A. D. 1875, by and between Elias Hake, of Fairview township, York county, State of Penna., and John J. Zacharias, of Lower Allen township, Cumberland county, State of Penna., witnesseth, that the said Elias Hake, does hereby lease, demise, and let unto the said John J. Zacharias, the three and one-half storied grist-mill with saw-mill attached, and two story dwelling house, with the necessary out buildings thereto appertaining, situate on the Yellowbreeches creek, in Allen township, Cumberland county, Penna., and adjoining properties of John Bitner and Martin Best, to hold for

the term of one year, from the first day of April, A. D. 1875; the said lessee, John J. Zacharias, yielding and paying rent therefor as follows, viz.:

First—Two-thirds of all the toll received for custom work done in the grist-mill.

Second—One-half of all the receipts from the saw-mill.

Third—Twelve and a half cents per barrel on merchant work manufactured for himself.

And the said lessee does hereby covenant to and with the said Elias Hake, that he will well and truly make the above payments of rent quarterly, viz.: on the first days of July and October, A. D. 1875, and on the first days of January and April, A. D. 1876; and the said lessee does further covenant and agree to make out and present to the lessor, at the end of every quarter, a full statement of all the work, custom or merchant, done in the mills during the quarter, and the lessor or his agents shall at all times have free access to the books of the mills; that he will not suffer nor permit any strip or waste of the premises; that he will not assign this lease, nor underlet the whole or part of the premises to any person or persons, nor make any alterations in the premises, without the consent, in writing, of the said lessor, his heirs or assigns; that he will quit and deliver up the premises to the said lessor, his heirs or assigns, peaceably and quietly, at the expiration of the term aforesaid, in as good order and condition as the same now is or may be hereafter put into, necessary wear and tear excepted; and the said lessor and his agents shall have the right, at all times, to enter the said premises to view the same, and to make repairs or alterations, upon giving the lessee ten days' notice; all new material required for repairs shall be furnished by the lessor, and all repairs requiring more than one day's work shall be paid by the lessor, the lessee to do or pay for all other repairs.

All brooms and oil used in the mills to be furnished by the lessee, the lessee to receive the sweepings of the mill for furnishing the same.

And the said lessor—Elias Hake—for himself, heirs, ex-

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ecutors and administrators, does hereby covenant to and with the said lessee, John J. Zacharias, that he shall quietly occupy the premises aforesaid, without hindrance or molestation from the said lessor, or any body claiming by or through him, the said lessee well and truly keeping and performing the covenants aforesaid on his part to be performed.

And the said lessee, John J. Zacharias, for himself, heirs, executors and administrators, does hereby covenant to and with the said lessor, his heirs, executors and administrators, that the said lessee, as aforesaid, shall punctually pay and discharge the rent aforesaid, as the same shall from time to time become due and payable, and all and singular the covenants aforesaid shall well and truly keep and perform.

In testimony whereof, the said parties have set their hands and seals, on the day and year first above written, and also to another paper of like tenor.

ELIAS HAKE [SEAL.]
J. J. ZACHARIAS [SEAL.]

Signed and sealed in the presence of Simon Horst.

Q. 11. On the fourth page of the paper which you have produced is another writing, which purports to be a lease of a tenement house and meadow adjoining the grist-mill; by whom was that signed?

A. That is myself and Mr. Zacharias.

By consent a copy of said last mentioned lease is offered in evidence as "Hake-Zacharias Tenement House Lease", instead of the original; the original to be produced when called for, and said copy to be subject to all legal objections which might be made to the original.

The copy is as follows:

This indenture, made this day of March, A. D. 1875, between Elias Hake and John J. Zacharias, witnesseth, that the said Elias Hake does hereby lease unto the said John J. Zacharias, for the term of one year from the

first day of April, A. D. 1875, the tenement house and meadows adjoining the grist-mill, the said John J. Zacharias agreeing to pay the yearly rental of seventy dollars; said rental to be paid quarterly.

ELIAS HAKE.
J. J. ZACHARIAS.

Witness, Simon Horst.
Fairview township, York county, Pa., March 1875.

Q. 12. At what time did Mr. Zacharias go into possession of the grist-mill under the lease?

A. I can't remember; it was in the spring of '75, about the first of April; I don't know whether it was on the very day or not.

Q. 13. How long did he remain in possession of the mill under that lease?

A. Under this lease one year.

Q. 14. State whether or not at the expiration of that year you made any other arrangement with him?

A. Yes, sir, we had; we had another article wrote different from this.

Witness produces article.

Q. 15. Was that second article ever executed?

A. Yes.

Q. 16. I mean was it ever signed by you and Mr. Zacharias?

A. No, it was not signed.

Q. 17. How did that happen?

A. Well, the article was wrote, and was given to Zacharias to examine whether he was satisfied with it or not; it was taken to the mill and was left there and was neglected; but we settled and he paid me the rent, according to this article.

Q. 18. For what length of time did he pay you rent according to this last agreement?

A. For one year.

By consent a copy of said last mentioned agreement is put in evidence, instead of the original, as

"Hake-Zacharias Unsigned Grist-mill and Tenement House Lease"; the original to be produced when called for, and said copy to be subject to all legal objections that might be made to the original.

The copy is as follows:

This indenture made and agreed and concluded upon this day of , A. D. 1876, between Elias Hake, of Fairview township, county of York, and State of Pennsylvania, of the first part, and John J. Zacharias, of Lower Allen township, county of Cumberland, and State of aforesaid, of the second part, witnesseth, that the said Elias Hake, by these presents, doth lease and let unto the said John J. Zacharias, the three and one-half storied mill, (grist-mill), with saw-mill attached, two dwelling houses, with the necessary out buildings thereto appertaining, and twenty acres of land, (be it more or less), situate on the Yellowbreeches creek, in Lower Allen township, Cumberland county, State aforesaid, and adjoining properties of John Bitner and Martin Best, to have and to hold the same for the term of one year, from the first day of April, A. D. 1876—the said John J. Zacharias, his heirs or assigns, yielding and paying to the said Elias Hake, his heirs or assigns, the sum of six hundred dollars, ($600), in manner following, to wit: The sum of one hundred and fifty dollars on the first day of July, A. D. 1876; the sum of one hundred and fifty dollars on the first day of October, A, D. 1876; the sum of one hundred and fifty dollars on the first day of January, A. D. 1877; and the sum of one hundred and fifty dollars on the thirty-first day of March, A. D. 1877; and further, should any of the aforementioned payments remain unpaid for the space of ten days after they become due, then the said John J. Zacharias, shall be considered a tenant at will, and the said Elias Hake shall have, without further notice, full power to again repossess himself of the above described premises; and further, the said John J. Zacharias, will not suffer or permit any damage or waste to said described premises; that he will not assign this lease nor underlet the whole or any part thereof of the aforementioned premises

to any person or persons, nor make any alterations in the premises without the written consent of the said Elias Hake, his heirs or assigns, and that he, the said John J. Zacharias, will deliver up without any further notice, peaceably and quietly at the expiration of the term of this lease, (viz. April 1, 1877), in as good order as it is now, or may perhaps be put into, necessary wear and tear excepted; and further, the said Elias Hake, his agents or employees, shall have the right at all times to enter said premises to view the same, and should said Elias Hake desire to make any repairs or alterations in any buildings or in any other way upon said premises, he, the said Elias Hake, shall give the said John J. Zacharias ten days' notice; and further, all new material required for repairs or alterations shall be furnished by said Elias Hake, and all repairing requiring more than one day's labor shall he paid by the said Elias Hake, and all other repairs, keeping machinery oiled, etc., shall be done and furnished by said John J. Zacharias; and the said Elias Hake, for himself, his heirs, executors or administrators, doth by these presents covenant to and with the said John J. Zacharias, that he, the said John J. Zacharias, shall quietly (*sic*) the premises aforesaid, without hindrance or molestation from said Elias Hake, or any person claiming by or through him, and the said John J. Zacharias truly and faithfully performing his part of the contract to the said Elias Hake.

In testimony whereof, the said parties to these presents have hereunto set their hands and seals, the day and year first above written, and also to another paper of like tenor.

Seal.

Witness: Seal.

Q. 19. After the expiration of the year for which you say he paid the rent in accordance with the unsigned article of agreement, did he remain at the mill, or not?

A. No; he went away that spring.

Q. 20. Has he ever occupied your mill at any time since that time?

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A. No, sir.

Q. 21. Who had possession of your mill before Zacharias took possession of it in the spring of 1875?

A. McCleaf; I forget his first name, and I don't know how to spell the last name.

Cross-examined by Mr. Storrow:

X-Q. 22. Who owns that grist-mill at the present time?

A. I own it.

X-Q. 23. How long have you owned it?

A. I think I bought it about 1872 or 1873; I am not sure; I couldn't tell you unless I would look at some of my papers.

X-Q. 24. Do you carry on any other business except the grist-mill?

A. Yes.

X-Q. 25. What?

A. Farming and distilling.

X-Q. 26. Where is your distillery?

A. Fairview township, York county.

X-Q. 27. How far from your grist-mill?

A. About a little over a mile.

X-Q. 28. How long have you carried on that distillery?

A. About twenty-six years.

X-Q. 29. Whom did you buy your grist-mill of?

A. I bought it at sheriff's sale.

X-Q. 30. Whose estate?

A. Michael Hurst's.

X-Q. 31. Was Michael Hurst living or dead at that time?

A. He was living at that time, but is dead now.

ELIAS HAKE.

Sworn and subscribed to before me this 10th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Abram Marquart, being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is about sixty-three; residence, Newville, Cumberland county, Pennsylvania; occupation, justice of the peace.

Q. 1. Were you formerly engaged in the insurance business; and if so, in what branch of the insurance business, and in what capacity?

A. I was engaged in the life insurance business, as an agent for soliciting insurance.

Q. 2. How long have you lived at Newville?

A. About seven years.

Q. 3. Where did you live prior to moving to Newville?

A. In a small village called Jacksonville, fourteen miles above Carlisle, on the Walnut Bottom road.

Q. 4. How long did you live there?

A. I moved there in 1856, and left in 1877.

Q. 5. While you were in the insurance business did you ever insure the life of anybody living at Eberly's Mills, Cumberland county, Pa.; if so, whom?

A. I did, Mrs. Sarah Fettron, wife of Daniel Fettron.

Q. 6. Did you enter any memoranda in your books concerning her life insurance.

A. I did.

Q. 7. Have you those books here; if so, will you please produce them, and point out the entries therein, in order that the examiner may copy them upon the records?

A. I have them here, and I produce them.

Witness produces two books; one being a ruled memorandum or account book about five by seven and a half inches in size, and containing one hundred and twenty-eight pages, which are paged consecutively on every alternate page, from page one to page sixty-four; and the other being a large blank insurance register of the Metropolitan Life Insurance Company of New Yoak, with printed rulings

for the columns of entries, and with a printed heading at the tops of the pages.

Q. 8. Are these books of original entries?

A. Yes, sir.

Q. 9. In whose handwriting are the written entries in them?

A. In my own handwriting.

Q. 10. Were they made in the regular course of your business at the time to which they relate?

A. Yes, sir.

Q. 11. Will you now point out in these books the entries relating to Mrs. Fettron's life insurance, in order that the examiner may copy them upon the record?

A. Yes, sir; in the small book are the following entries:

Q. 12. Referring to the first item about Mrs. Fettron in your smaller book, on page 3, in what year, as shown by the book was that first date, February 27th?

A. In 1872.

Q. 13. When did Mrs. Fettron take the policy of insurance?

A. I don't remember, that was the date of the policy; I don't remember whether she got it on that date or a few days afterwards.

Q. 14. If I understand your book entries, Mrs. Fettron finally surrendered that policy and took a paid up policy?

A. Yes, she did.

Q. 15. When did she do that?

A. December first, 1875.

Q. 16. Were you ever in the village of Milltown or Eberly's Mills yourself?

A. Yes, sir; I was.

Q. 17. When were you in that village for the last time?

A. That was December first, 1875, when I delivered that paid up policy to Mrs. Fettron.

Q. 18. Do you know Daniel Drawbaugh, of Eberly's Mills, if so, how long have you known him?

A I do know him; I think about 1870 or 1871 I became acquainted with him.

Q. 19. Were you ever in his shop or mill at Eberly's Mills?

A. Yes, sir; I was.

Q. 20. Were you in his shop on the occasion when you delivered the paid up policy to Mrs. Fettron?

A. No, sir; I wasn't.

Q. 21. When were you in his shop for the last time in your life?

A. Some time between the 27th of February and the middle of March, 1875?

Q. 22. What did you go down to Eberly's Mills for on that day between the 27th of February and the middle of March, 1875?

A. To get him to take a risk of life insurance on his life.

Q. 23. What other business did you transact at Eberly's Mills that day?

A. Mrs. Fettron paid me her semi-annual premium.

Q. 24. In your smaller book, on page 56, under the head of "reported" is the date of "April 16, 1875", what does that mean?

A. That means; reported her premium to the company, less my commission.

Q. 25. How long a time did the company allow you to report premiums after you had received them?

A. We generally reported them from the first to the tenth or fifteenth of the month succeeding that in which we collected them.

Q. 26. When did you first speak to Mr. Drawbaugh about taking a life insurance on himself?

A. Along about 1872 or 1873; I don't just remember the time when I first talked to him about it.

Q. 27. How often did you speak to him about it, from the first time until the spring of 1875?

A. I couldn't tell the number of times exactly, but quite a number of times; I talked to him about it every time I seen him.

Q. 28. Did he express any desire to take out a policy himself or not?

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Objected to as leading, as asking for hearsay, as too remote and as immaterial.

A. He did; he appeared anxious to take one.

Q. 29. Did he give you any reason for not taking one, if so, what was it?

A. Yes, sir; he always complained of being too poor to pay the premium.

Q. 30. How often did he made this statement to you when you solicited him to take a policy?

A. Nearly every time that I spoke to him about insursurance, he appeared to not be able to do it.

Q. 31. When did you last speak to him, soliciting him to take a policy?

A. The last time I remember distinctly, was the time I was there to collect that last premium of Mrs. Fettron.

Q. 32. Why did you never go to his shop after that to solicit him?

Objected to as too remote, and calling for guess work and opinion, and as immaterial.

A. Because I gave up to get him insured, because he always complained of poverty.

Q. 33. I notice that your books contain no entry of the payment of Mrs. Fettron's premium which was due on the 27th of August, 1875; how do you explain that?

A. She never paid it; she took a paid up policy afterwards, and surrendered her old one.

Q. 34. Do you remember what the weather when you were last at Mr. Drawbaugh's shop, to wit: between the 27th of February and the middle of March, 1875?

Objected to as leading.

A. The weather was cold; I don't remember whether it was raining or anything of that kind, but it was cold weather.

Q. 35. Do you remember in what part of Mr. Drawbaugh's shop you were that day, and how you got in?

A. I got in from the outside to the first floor, and went up on the inside to the second floor, and on the upper floor was a little room that he was working in, where I found him.

Q. 36. Who else was in the shop at the time, if anybody?

A. I don't remember of anybody else being in the shop at the time.

Q. 37. Do you remember whether the machinery of the shop was running or still?

A. I don't remember whether they were running, or not.

Q. 38. Do you remember what Mr. Drawbaugh was doing in the little room when you found him there?

A. He was working at a little box; he called it a talking-machine, or curved magnet.

Q. 39. Describe it, as you remember it?

A. It was a small round box, probably three inches in diameter, and about an inch and a half deep; and in that he had a circle made of steel or iron, and on the one side of it there was a mouth-piece appeared.

Q. 40. Please look at the two instruments, exhibits "P" and "E", now shown you, and state whether you ever saw them or either of them before; and if so, when for the first time?

A. I did see—I don't remember exactly which of them; but it was one of them two that he showed me at that time—the time I was there; the time I was there was between the 27th of February and middle of March, 1875.

Q. 41. What was it that Mr. Drawbaugh spoke of as the curved magnet?

A. It was this here (indicating magnet on back of exhibit "P".)

Q. 42. Did Mr. Drawbaugh tell you what use was to be made of this machine?

A. He told me it was to take the place of telegraphing.

Q. 43. Did he tell you how it was to be operated?

A. He told me by electricity.

Q. 44. Did he explain to you how the machine was to be used, in operating it?

A. He did; he said, by a person talking into this machine, another person could hear at any distance over a wire connecting the two together.

Q. 45. During that visit to his shop, between the 27th of February and middle of March, 1875, while you were talking with him about this instrument, was anything said about patenting it?

Objected to as calling for hearsay.

A. Yes, sir; he talked about getting it patented, but said he was too poor to have it done.

Q. 46. You were requested by me this morning to go into the examiner's room with the examiner, Mr. Ott, and myself, and look at the exhibits, to see if you could pick out the machine which you saw at Mr. Drawbaugh's shop in the spring of 1875, were you not?

Objected to as leading and incompetent.

A. Yes, sir.

Q. 47. And you picked out these two instruments from the others; did you?

Same objection.

A. Yes, sir; as one of them that Mr. Drawbaugh showed me at that time.

Q. 48. Had you ever seen them from the time you saw them, or it, in the spring of 1875, until this morning?

Same objection.

A. No, sir.

Q. 49. What public offices have you held in your town or county?

A. None but justice of the peace.

Cross-examined by Mr. Storrow:

X-Q. 50. Did Mrs. Fettron pay all her premiums up to August, 1875?

A. She paid all but the August premium of 1875, which she did not pay.

X-Q. 51. Then she paid premiums for three years and a quarter?

A. She paid for three years and a half.

X-Q. 52. And the annual premium was $31.30, was it?

A. It was $31.30; I see one place it is marked $31.31, but $31.30 was the annual premium.

X-Q. 53. Then she paid your company something over $100 in cash, and in return for that got a paid-up policy for $90; did she.

A. I don't know what the paid-up policy was; I guess that is right, when I come to examine the book closely; yes, that's right.

X-Q. 54. And you understood that Mr. Drawbaugh did not think himself rich enough to insure in such a company?

A. No, sir; he did not consider himself rich enough to insure.

X-Q. 55. Is this larger book one which belonged to you or one which you sent to the company?

A. The company always furnished us with a book of that kind, and then we had blanks that we made out the reports on; we didn't send back the book.

X-Q. 56. According to your testimony, you have got seven entries about Mrs. Fettron in your smaller book, and only one in the larger one; how does that happen?

A. The reason of that is, in this smaller book we kept what we called the renewal premiums; the original policy, I think, is entered in the large book, and the first premium; the smaller book is one I made for myself; I could carry it with me; the other one I could not.

X-Q. 57. You have testified that in the large book there is but one entry, that of the second policy; do you now wish to corrrct that? Is there another entry in that book relating to Mrs. Fettron?

A. In regard to that one entry, I had reference to the entry of her paid-up policy, because I didn't have it in the smaller book; now, there may be some other entries in the large book, but they are all in the smaller book, except the entry about the paid-up policy.

X-Q. 58. Well, you look in the larger book, and see whether there are any other entries about her?

(Witness examines the book.)

A. It does appear one other time in this larger book, but that was the original entry—February 27th, 1872. It was

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then carried into the other book so that it would be more convenient for me to carry.

X-Q. 59. Tell me everything you remember ever to have seen in Drawbaugh's shop?

A. I couldn't tell you; I was at the shop frequently. I saw a few buggy-axles that were made there one time; and I saw those talking-machines that he was making, because he was always talking about them, but I couldn't tell what all I seen there. There was a number of things that he had, back and forward, but he was excited and talking about his patent or invention, and I was talking life insurance to him.

X-Q. 60. Can't you remember anything else you ever saw there; and if so, tell me what it is?

A. I don't remember distinctly anything else because the most of the times I did meet him was up in his little room.

X-Q. 61. Is it your recollection that he talked to you about a talking-machine pretty much every time you went there?

A. Generally our conversation was, the talking-machine and life insurance; that is to the best of my recollection.

ABRAM MARQUART.

Sworn and subscribed to before me this 10th day of February, 1885.

FRED M. OTT,
Special Examiner.

Mrs. Jeremiah Fry being produced, sworn and examined, saith:

Examined by Mr. Jacobs:

Q. 1. Where do you reside?

A. At Shiremanstown, Cumberland county.

Q. 2. Did you formerly reside at Eberly's mills, Cumberland county, Penn.?

A. Yes, sir.

Q. 3. When did you go there to live?

A. In 1875, the last week in March.

Q. 4. Your husband, Jeremiah Fry, testified in the case of American Bell Telephone Company and others against the People's Telephone Company and others, that he had kept store at Eberly's Mills; can you tell us when he began to keep store there?

A. In 1875, in the latter part of September; we moved there in the latter part of September—where the store was.

Q. 5. In what house in Eberly's Mills did you first reside?

A. In an old house that is torn away now—where Clendinnin's store-house is now.

Q. 6. How long did you continue to live in that old house?

A. We lived there from the last week in March till the last of September.

Q. 7. Who moved into that old house after you left it?

A. To the best of my knowledge, Jake Evans.

Q. 8. Was the store-house into which you moved in September, 1875, an old house, or a new one?

A. It was built new.

Q. 9. How long had it been finished when you moved into it?

A. It was just completed, and we moved right into it?

Q. 10. Whereabouts in the town was it located?

A. At the lower end, just opposite the grist-mill.

Q. 11. Between the time you moved to Milltown, in March, 1875, and the time you moved into the new store-house in September, 1875, where did you purchase your family supplies?

A. The most in Harrisburg.

Q. 12. Did you purchase any of them anywhere else than Harrisburg?

A. A couple of times I got from Gardner, right alongside of us there.

Q. 13. What was his full name, if you know, and whereabouts did he live?

A. His name was Harry Gardner, and he lived the next house above us, up on the hill like.

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Q. 14. What kind of grocery supplies did you purchase from him?

A. Sugar, coffee and matches.

Q. 15. Who kept the post-office at that time?

A. Mr. Gardner, the same man.

Q. 16. Up until what time did he keep it?

A. Up until October the first, 1875.

Q. 17. Who took it then?

A. My husband, Mr. Fry.

Q. 18. Where did Mr. Gardner keep the post-office when he had it, and where did your husband keep it?

A. Mr. Gardner kept it in the house where he lived up above us, and we kept it in the new store-house.

Cross-examination waived by Mr. Storrow.

MRS. JERE. FRY.

Sworn and subscribed to before me this 10th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Recess until 8 P. M.

Levan H. Orris being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is fifty years; residence near Newville, Cumberland county, Pa.; occupation, farmer.

Q. 1. Were you formerly the treasurer of Cumberland county?

A. Yes, sir.

Q. 2. When were you elected to that office?

A. In the fall of 1873.

Q. 3. Did you make a personal canvass of the county prior to your election?

A. Yes, sir.

Q. 4. Do you remember at what time the nominating

convention was held that year at which you were nominated?

A. It was held in the beginning of August, some time; I can't tell the time exactly.

Q. 5. Do you know Daniel Drawbaugh, of Eberly's Mills, or Milltown, Cumberland county?

A. Yes, sir.

Q. 6. Were you ever in his shop at Milltown?

A. Yes, sir.

Q. 7. How many times were you ever in his shop?

A. Once.

Q. 8. When was that?

A. It was before the convention; I couldn't tell the time exactly, but it was the latter part of July, 1873.

Q. 9. What caused you to go to his shop that day?

A. Politics.

Q. 10. Were you then canvassing for your own nomination?

A. Yes, sir; I was a candidate.

Q. 11. Whom did you see at Mr. Drawbaugh's shop that day?

A. I don't remember of seeing anybody there but Mr. Drawbaugh?

Q. 12. In what part of the shop did you find him?

A. I found him in the basement.

Q. 13. Down where the water-wheel was?

A. Yes, sir.

Q. 14. Do you remember what he was doing there?

A. No, sir.

Q. 15. What took place there in the basement that day?

A. After we had talked a while on politics, he says: "Orris, come along with me up stairs; I want to show you a talking-machine."

Q. 16. What was then done?

A. He said that he could talk through it to his family; he did talk through it to some person.

Q. 17. When he asked you to go up stairs that he might show you the talking-machine, did you and he go upstairs together?

A. Yes, sir.

Q. 18. Into what part of the shop did you go?

A. We went up stairs.

Q. 19. Do you remember whether you went up on the first or second floor?

A. Second floor.

Q. 20. And there, what did he show you, if anything?

A. He showed me a box that he talked through.

Q. 21. And, if I understand you correctly, he talked to somebody through it?

A. Yes, sir.

Q. 22. Do you know who the person was that he talked to, or whereabouts?

A. No, sir.

Q. 23. Did you talk into the machine or listen at it?

A. No, sir.

Q. 24. How did you know that Drawbaugh talked to anybody or heard from anybody?

A. He told me; "I'll just talk through this", but just who or where he talked I can't tell you. Drawbaugh mentioned the name of somebody, as if I would say: "I'll talk to Smith", or somebody else; but who it was I don't remember.

Q. 25. Why didn't you have the curiosity to talk into the machine or listen at it?

A. Well, I took no interest in it.

Q. 26. If the machine had been a politician's ear, I suppose you would have talked through it, wouldn't you?

A. Yes, I suppose I would.

Q. 27. Did you understand at the time, that the other man talked back through the machine to Mr. Drawbaugh, or not?

Objected to as asking for hearsay and guess work.

A. I did.

Q. 28. How did you get that idea at the time?

A. I heard them talk.

Q. 29. Did you hear the other man talk, or how did you hear?

A. I heard him talk to the other man and then he told me what was said.

Q. 30. What he said, or what the other man said back to him?

A. He told me what the other man answered him.

Q. 31. Did you take enough interest in the matter to examine the machine carefully?

A. I did not.

Q. 32. Did Mr. Drawbaugh tell you how far he could talk to anybody through this machine?

Objected to as asking for hearsay.

A. I don't remember; he said this: "If I had the wires, I can talk quite a distance".

Q. 33. Did he tell you how the machine operated?

Objected to as leading.

A. He told me it operated through electricity.

Q. 34. Was anything said that day there about patenting the machine?

Same objection.

A. Yes, sir.

Q. 35. What was said about that and who said it?

A. Mr. Drawbaugh said that he intended to get it patented; that he was poor but expected to get help.

Q. 36. When you were canvassing in Cumbeland county for your nomination and election that year, did you hear anything said about Drawbaugh's talking machine around in the county?

Objected to as hearsay.

A. I did, in the lower end of the county.

Q. 37. Do you remember who spoke of it?

Same objection.

A. No, sir.

Q. 38. Did you hear of it several times, or only once during that canvass?

A. If my memory serves me right, I heard it frequently.

Cross-examination waived by Mr. Storrow.

LEVAN H. ORRIS.

Sworn and subscribed to before me this 10th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Recess until 8 P. M.

February 10, 1885, 8 P. M.

Present: Same counsel.

Complainants request that the witness Levan H. Orris, be recalled for further cross-examination.

Respondents' counsel replies that Mr. Orris was discharged, and, he supposed, had gone home; but that he is at this moment informed that Mr. Orris is still in this building, and he will go and see whether he can get him for cross-examination.

Levan H. Orris being recalled for further cross-examination, saith:

Cross-examined by Mr. Storrow:

X-Q. 39. How long did you serve as county treasurer?

A. Two years.

X-Q. 40. I find in the *Carlisle Mirror* of February 11, 1876, what purports to be a part of the report of the auditors and commissioners of Cumberland county for the year ending December 31, 1875, and that it contains the following:

"We, the undersigned, auditors of Cumberland county, in the commonwealth of Pennsylvania, do certify that in pursuance of the act of Assembly relating to counties, etc., we met in the court-house in the county of Cumberland, on the 3d day of January, A. D. 1876, and from time to time thereafter; that Levan H. Orris, the treasurer of said county for the year 1875, was duly notified of said meeting and appeared before our said board, and that we did audit and adjust the account of the said Levan H. Orris, treasurer of said county, in account with the county from the 1st day of January, A. D. 1875, to the 1st day of January, A. D.

1876, as required of us by law, according to the best of our judgment and ability. And we further declare, that we find the said Levan H. Orris, treasurer of said Cumberland county for said year 1875, in default. The defalcations being produced by erasing figures and words, also by adding certain figures and interpolating false entries in place of originals, thus, by a series of various devices, changing a number of commissioners' bills from their original face value to fictitious values; also, in one instance we find a bill among others produced by said treasurer, purporting a certain amount of money as having been paid by him to a jury, which jury, unfortunately, did not exist at all. We are thus free to say that some agency was employed to abstract, and did abstract, from the treasury of said county, to the best of our knowledge and belief, the sum of four thousand eight hundred and seventy-one dollars and sixty-five cents. In proof of which declaration, we have in evidence official records, as well as the sworn testimony of some of the persons having a knowledge of some of the facts set forth. And now, to wit: that we find a balance due the said county of Cumberland from Levan H. Orris, treasurer as aforesaid, of thirteen hundred and eighty-one dollars and thirty cents ($1,381.30), as above set forth, all of which is respectfully submitted. Witness our hands and seals, at Carlisle, this eighth day of February, 1876.

"CHAS. E. WOLF,
"HUGH BOYD,
"THOMAS R. BERGNER,
"Auditors."

Are you the Levan H. Orris spoken of in this report?

Objected to as incompetent.

A. Yes, sir; I am.

X-Q. 41. I find in the *Carlisle Mirror* for March 7, 1876, the following:

"Fled the Country.—For a week or more past, rumors have been afloat that Levan H. Orris, late county treasurer, had fled the country, leaving his property in the charge of

his family. Careful and diligent inquiry elicits a confirmation of the rumor."

Did you leave Cumberland county about that time?

Objected to as incompetent.

A. Yes; I had left about that time.

X-Q. 42. In the *Carlisle Mirror* of April 18, 1876, under the head of "Court Proceedings," I find the following:

"A true bill was found against Levan H. Orris, late county treasurer, for embezzlement."

Were you so indicted for embezzlement?

A. I think so; I think the grand jury did find a true bill against me; I wasn't here at that time.

X-Q. 43. Where were you at that time?

A. I was in Johnson county, Iowa.

X-Q. 44. When did you return to Cumberland county?

A. We returned the spring of 1877.

X-Q. 45. Your bondsmen were called upon to make good the balance of your account, were they not?

A. No, sir; I paid the money all over the day the auditors filed their report—every dollar of it; if I was at home I could show the date, but I haven't the receipt with me.

X-Q. 46. Subsequently the indictment was dropped, in consideration of your having paid up the balance, was it not?

Objected to as calling for a statement which must necessarily be hearsay.

A. No, sir; I paid up the balance, as I told you, the day the auditors filed their report; there was no suit brought against me then.

Respondent's counsel objects to the entire cross-examination as utterly incompetent and immaterial and, without waiving any objection already taken on the record, re-examines the witness *de bene esse*.

By Mr. Hill:

Q. 47. Did you make any of the fraudulent entries, eras-

ures or alterations referred to in the questions asked you on cross-examination?

A. No, sir; those are the commissioners' orders that were paid by the commissioners' clerk; my vouchers are all right and straight, and I can show it up.

Q. 48. Did you personally have anything to do with the defalcation in the treasurer's office?

A. No, sir.

Q. 49. Will you explain the history of that transaction, as you understand it?

A. In the first place, there was bills brought in paid by the commissioners' clerk, marked on the back of them: "Order granted" or "O. G." which meant "order granted"; the amount of the bill was marked on the outside; I would pay those commissioners' orders or bills; I kept them in my drawer till they would accumulate, then I would hand them to Mr. Floyd, the commissioners' clerk; he would paste those bills together—road orders under their appropriate head, witness bills under their appropriate head, bridge bills—and I could go on to enumerate various kinds of bills, all under their appropriate heads; he would add them up at his leisure; sometimes they would be in his possession for a week or more; then he would hand them over to me and the commissioners to add them up again to see whether he was correct or not; then he would fill out vouchers for the different bills for the different amounts; the three commissioners signed those vouchers; during the time I was out collecting tax, he paid all the commissioners' orders, while I was out collecting; when I got into the office and he had those bills pasted together again, added up, and the vouchers filled out for the amounts, I paid the money for them.

Q. 50. Where is he now?

A. In Carlisle.

Q. 51. What became of the indictment which you think was found against you?

A. It was quashed; I never heard any more about it; when I came home it was all over.

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Q. 52. Did you make the county good before you went away?

A. Yes, sir; I made it as I said—I made the county good; I paid every dollar; before I left Carlisle I owed Cumberland county nothing.

Q. 53. Did you ever pay any of the county money out, knowing it to be improper to so pay it?

A. No, sir.

Q. 54. When you first heard of the Bell telephone being exhibited or introduced into use, what did you think about it?

A. I thought it was the same talking-machine that I saw down there at Drawbaugh's.

Q. 55. How long did you continue to think that the telephones that were in public use were the Drawbaugh telephones, and before you knew that some other man claimed the invention?

A. When I saw in print that there was a law suit concerning this telephone; that was the first I knew about it.

Q. 56. Do you mean the law suit between the Drawbaugh and the Bell party?

A. Yes, sir; I seen it in print, that there was a law suit, another party claiming the right.

Q. 57. Where have you lived since the spring of 1877?

A. I have lived in Frankford township, Cumberland county, from 1877 till the year 1881; I then moved to West Pennsboro, and have lived there up to this time.

Q. 58. How far is your residence in West Pennsboro from the village of Newville, Cumberland county?

A. One mile.

Q. 59. Did you ever unlawfully take or appropriate to your own use any of the county moneys or property while you were county treasurer?

A. No, sir.

Q. 60. Did you knowingly allow anybody else to do so?

A. No, sir.

Re-re-cross by Mr. Storrow:

X-Q. 61. When was it that you first heard of the Bell telephone being exhibited or introduced into use?

A. That I can't tell you. Do you mean public use?

X-Q. 62. You have testified that when you first heard of the Bell telephone being exhibited or introduced into use, you thought it was the same telephone that you had seen down at Drawbaugh's; when was it that you first heard of the exhibition or introduction into use of the Bell telephone?

A. I don't remember how long it was after I saw the talking-machine at Mr. Drawbaugh's.

X-Q. 63. How came you to hear first that the Bell telephone had been exhibited or introduced into use?

A. I saw it in print.

X-Q. 64. Where did you see it in print?

A. In my own house.

X-Q. 65. What was the print in?

A. Newspapers.

X-Q. 66. What newspapers?

A. That I can't tell you; I don't remember.

X-Q. 67. What was it that you read about the Bell telephone in those papers at that time?

A. I can't come over the words, but I know this, that I read that there was a telephone in use, that you could talk together from one town to another.

X-Q. 68. What newspapers were you in the habit of reading at that time?

Objected to as too remote and as trying to lay a foundation for mere guess work.

A. I get all of the county paper and buy daily papers.

X-Q. 69. Name the county papers you were getting at that time?

Same objection.

A. I can't tell you what time I saw this in print.

X-Q. 70. You have just testified: "I got all of the county papers"; name the papers you refer to in that answer.

Same objection.

A. Well, *Carlisle Herald*, *Carlisle Volunteer*, *Sentinel*, *Shippensburg Chronicle*, *Star of the Valley*, at Newville, *Enterprise:* the Mechanicsburg paper I get occasionally.

X-Q. 71. How long have you been in the habit of getting those papers?

Same objection, and further objected to as immaterial and mere wasting of time.

A. The *Volunteer* I have been getting since 1860; the *Herald* and *Sentinel*, if I mistake not, since 1875; the others I don't remember how long I have been taking.

X-Q. 72. Where was it that you first saw in print that there was a lawsuit going on between the Drawbaugh party and the Bell party?

A. I don't remember that.

X-Q. 73. What print did you see that in?

A. I saw it in the newspapers, but I don't remember what paper.

X-Q. 74. How long have you and Henry F. Drawbaugh known each other?

A. I have known Henry Drawbaugh, I think, I dare say, for thirty years.

LEVAN H. ORRIS.

Subscribed to before me this 10th day of February, 1885.

FRED. M. OTT,
Special Examiner.

George Emrick being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is sixty-four; residence Hazleton, Luzerne county, Pa.; occupation, keeping a sale and exchange stable, dealing in horses and mules.

Q. 1. Did you formerly live at New Cumberland, Cumberland county; if so, when?

A. Yes sir; I moved there in April, 1870, and lived there four years.

Q. 2. Do you know John M. Woodburn, of Cumberland county?

A. Yes, sir; I do.

Q. 3. Did Mr. Woodburn ever visit you at New Cumberland, Cumberland county?

A. Yes, sir; he visited me either the last of July or the first of August—I think, though, July, if my memory serves me, of 1873.

Q. 4. What business was he in at that time?

A. He was there—or came to me—trying to secure the delegates of the county for himself for treasurer.

Q. 5. Was he a candidate for county treasurer that year?

A. He was a candidate for county treasurer at that time, sir.

Q. 6. What did you do to aid him, if anything?

A. I got a team, went to see Mr. Mumper; from there went to see Mr. John Drawbaugh, who was a political worker, and he was not at home; he was down at his brother Daniel's shop, and we went down there to see him, and found him on the middle floor, and had our conversation with him about the delegates of Lower Allen township and other townships adjoining; and after that was done, Mr. Daniel Drawbaugh drawed our attention to his talking-machine; he asked some one to go up on the third story, and we went down into the wheel-pit or wheel-house below, on the ground floor, and he would talk with some man upstairs, and ask him questions: he would answer back, and he would explain—tell us what he said; we couldn't hear what he did say, but he would say that he said such things; I didn't listen and didn't hear it.

Q. 7. You say "we" went down into the wheel-pit; who do you mean by "we"?

A. Mr. Daniel Drawbaugh, Mr. Woodburn and myself.

Q. 8. Then Mr. Woodburn accompanied you on your trip around from New Cumberland, did he?

Objected to be leading.

A. Yes, sir.

Q. 9. After you got through at Mr. Daniel Drawbaugh's shop, where did you and Mr. Woodburn then go?

A. We went to Lisburn and Upper Allen township.

Q. 10. Did you ever go on a political trip with Mr. Woodburn at any other time?

A. No, sir; not at any other time.

Q. 11. When you and Mr. Woodburn were in Daniel Brawbaugh's shop that day, did you see the machine that Mr. Drawbaugh talked into?

A. I did, sir.

Q. 12. Where was the part of it that you saw?

A. It was in the lower part of the mill there?

Q. 13. Explain just what you mean by the lower part of the mill?

A. I mean the ground floor—wheel-house, a wheel-pit, a whatever you choose to call it.

Q. 14. Down in the cellar, where the water-wheel was, you mean?

A. Yes, sir.

Q. 15. You say Drawbaugh asked some one to go up on the third story; do you know who that person was?

A. I do not, sir; I couldn't mind.

Q. 16. Did you go up on the third story that day?

A. No, sir.

Q. 17. Then, I suppose, you didn't see the machine that the man talked into up on the third story?

A. No, sir; I didn't see it.

Q. 18. When Drawbaugh was talking into the machine down in the cellar, did he hold the machine in his hands, or was it setting on something?

A. My impression is it was either setting on a board, or a bench, or a shelf; I am not positive which, but think it was a bench—or fastened on it; I couldn't tell which.

Q. 19. How did Drawbaugh operate the machine, as you saw him do it that day?

A. If my memory serves me right, I think it was a round

something like a barrel, with a hole in the top, may be two inches, or inch and a half, as near as I can tell you. He put his mouth in this shape, (indicating); and he would force his voice into that hole as near as I can tell—force his voice into that hole—his speech.

Q. 20. And when he listened?

A. I can't say whether he put his ear to the same hole, or whether he put his ear to another hole or instrument that he received the message from, or intelligence.

Q. 21. How was the instrument connected to the third floor?

A. By a wire, as I imagined, that run up through the second floor.

Q. 22. Did Drawbaugh explain to you that day, how the machine operated?

A. Yes, sir; by electricity he told me it was operated.

Q. 23. Did he tell you that day how far he could talk through the machine?

A. He did'nt say how far he could talk, but he said he could talk for miles, I think he said ten or twenty miles—miles, any way, he said, or words to that effect.

Q. 24. Was anything said that day about patenting the invention?

A. Yes, sir.

Q. 25. What was said about it?

A. He said he didn't have the funds to have it done at that time.

Q. 26. Please look at the machines "F", "B", "C" and "I", now placed on the table before you, and see whether you recognize any of them as the instrument you saw that day at Mr. Drawbaugh's shop?

A. I think this is what I saw, (indicating "I"), as near as my memory serves me, something like this, something in this shape—this—what I should say today is the thing I saw at that time, as near as I can tell.

Cross-examination waived by Mr. Storrow.

GEORGE EMRICK.

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Sworn and subscribed to before me this 10th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Adjourned until February 11th, 1885, at 10 A. M.

Samuel C. Wagner, being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is about forty-two; residence, Newville, Cumberland county, Penna.; occupation, grain and flour dealer.

Q. 1. How long have you resided in Newville?

A. For the past forty-two years, except the time I was in the army—three years.

Q. 2. Are you at the present time a member of the Pennsylvania State Senate?

A. Yes, sir.

Q. 3. What senatorial district do you represent?

A. The thirty-second—Adams and Cumberland counties.

Q. 4. Do you know Levan H. Orris, who was formerly county treasurer of Cumberland county?

A. I do, sir; I know him very well.

Q. 5. Do you know what his general reputation in the community has been for truthfulness, honesty and general integrity, as a citizen, since the alleged defalcation in the county treasurer's office, during his term of office, and down to the present time?

A. Immediately after the alleged defalcation, of course, he was under a cloud; but that was accounted for by the charges made by the newspapers; Mr. Orris closed up his accounts satisfactorily to everybody in the county, so far as I know, and today he is regarded as one of the best citizens in our community; that I have no hesitation in saying.

Q. 6. The public and general opinion of the community, where all these things took place and where all the people

connected with them are known, has acquitted him of all complicity in the wrong?

Objected to as leading.

A. Yes, sir; the people in the community in which he resides, and where I myself reside, regard him as entirely innocent of the charges made against him.

Cross-examined by Mr. Storrow:

X-Q. 7. Is Mr. Orris any relation of yours?

A. No, sir; none at all.

X-Q. 8. Any connection by marriage?

A. No, sir.

X-Q. 9. How long have you known him?

A. I have known him for at least twenty-five years.

X-Q. 10. How near to you does he live?

A. About a mile from where I reside.

S. C. WAGNER.

Sworn and subscribed to before me this 11th day of February, 1885.

FRED. M. OTT,
Special Examiner.

Recess until 2 P. M.

February 11, 1885, 2 P. M.

Present: Same counsel.

Mr. Chas. Hawson for complainants.

G. M. P. Eckels being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is forty; residence Mechanicsburg, Cumberland county, Pa.; occupation, teacher.

Q. 1. What official position do you hold at the present time?

A. Member of the Legislature of Pennsylvania.

Q. 2. Do you know Levan H. Orris, formerly treasurer of Cumberland county?

A. I do.

Q. 3. How long have you known him?

A. I have known him for at least fifteen years.

Q. 4. During that time, have you known his general reputation in the community in which he lives, and around in Cumberland county, for integrity and truthfulness?

A. From general reputation, you mean? Of course, you understand that I live some ten or fifteen miles away from him; from general report his reputation is good.

Q. 5. What effect, if any, had the alleged defalcation in the treasurer's office during his term, had upon his general standing in the community?

Objected to as incompetent.

A. Not any.

Q. 6. Are you in any way related to him or connected to him by marriage?

A. In no way whatever.

Cross-examined by Mr. Hawson:

X-Q. 7. I judge from your answer to interrogatory 4, that living at a considerable distance from Mr. Orris you have had no particular dealings with him nor occasions to inquire as to his reputation or to hear his reputation discussed?

A. I have had no particular dealings with him; in my political canvasses of the county, coming in contact with men from his own community, I have gathered the impression that his reputation was good.

G. M. P. Eckels.

Sworn and subscribed to before me this 11th day of February, 1885.

Fred. M. Ott,
Special Examiner.

John Graham being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is forty-one; residence Newville, Cumberland county, Pa.; occupation, tanning business.

Q. 1. What official business do you hold at the present time?

A. I am a member of the Pennsylvania Legislature.

Q. 2. Do you know Levan H. Orris, formerly treasurer of Cumberland county?

A. I do.

Q. 3. How long have you known him?

A. I have known him at least twenty-five years.

Q. 4. How far do you live from him?

A. Within about a mile.

Q. 5. How long have you lived at Newville?

A. I have lived in Newville since 1866.

Q. 6. Do you know what Mr. Orris' general reputation is in the community where he lives and around in Cumberland county for integrity and truthfulness?

A. It is good.

Q. 7. What effect, if any, has the alleged defalcation in the treasurer's office during his term had upon his general reputation and standing in the community where he lives?

Objected to as incompetent.

A. It has not affected his reputation.

Q. 8. What was his general standing and reputation in the community before the alleged defalcation?

A. It was good.

Q. 9. Are you in any way related to him or connected to him by marriage?

A. No, sir.

Cross-examination waived by Mr. Hawson.

JOHN GRAHAM.

Sworn and subscribed to before me this 11th day of February, 1885.

FRED. M. OTT,
Special Examiner.

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February 11, 1885, 10:15 A. M.

Examination resumed.

Present: Same counsel.

John M. Woodburn being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is fifty-one; residence, Newville, Cumberland county, Penna.; occupation, dealer in stock.

Q. 1. Were you ever at any time a candidate for the office of county treasurer of Cumberland county, Penna.?

A. I was a candidate for the nomination; I was never the candidate as the nominee.

Q. 2. How near did you come to being nominated in that convention?

A. So near that there was a tie vote at one time in that convention.

Q. 3. What year was that?

A. 1873.

Q. 4. Who was your successful competitor for the nomination in that convention?

A. Levan H. Orris.

Q. 5. Mr. Orris was elected, and held office for a term, did he not?

A. Yes, sir.

Q. 6. Mr. Orris was examined as a witness here yesterday, and in his cross-examination some newspaper extracts were used by the complainants in an attempt to impeach his character, through reflections which they contained upon him, relating to an alleged defalcation in his office while county treasurer; you have heard of that defalcation, I suppose?

A. Yes, sir.

Q. 7. How long have you lived in Cumberland county?

A. I have lived there all my life; I have lived forty years in Newville.

Q. 8. Have you known Mr. Orris, and known of his gen-

eral standing in the community since the alleged defalcation?

A. Yes, sir.

Q. 9. How does he stand in that community today, as regards his reputation for honesty, integrity and truthfulness?

A. He stands very good there as a citizen; he stands number one throughout the community.

Q. 10. What is the general opinion of the community around where Mr. Orris lives, as to his having been guilty of any participation in the alleged defalcation or wrong doing in the treasurer's office during his administration of the office?

A. They declare him entirely innocent of all charges made by the papers against him.

Q. 11. Can you give me the exact date when the county convention was held in 1873, at the time when you were an aspirant for the office of county treasurer?

A. Yes, sir.

Q. 12. Please state the date?

A. (Witness refers to pocket diary.) Monday, August 11, 1873.

Q. 13. During your canvass for the nomination for county treasurer that year, did you at any time go to Milltown or Eberly's Mills in connection with your canvass?

A. Yes, sir.

Q. 14. Will you tell us how you went there—where you went from, and, after you got through your business at Eberly's Mills, where you went to; and if you were accompanied by anybody, state who it was?

A. I left Newville on Monday, July 14, 1873, in the early train, got off at Bridgeport, walked to New Cumberland from Bridgeport and met Mr. George Emrick there, and we hired a team there and went from New Cumberland to Mr. George Mumper's, in Lower Allen—left Mr. Mumper's and went to Milltown to see Mr. John Drawbaugh. We went to his house and were told that Mr. John Drawbaugh was down at the shop of his brother, Daniel Drawbaugh. We

seen Mr. John Drawbaugh in the shop with Daniel. After we got through there, we went on to the road to Lisburn—on and off of the road, back and forward, hunting up Democrats; I was after my nomination—we then went to Lisburn.

Q. 15. Did you keep a diary that year?

A. Yes sir; I have been keeping a diary regularly, as a general thing, for some years back.

Q. 16. Have you here your diary for 1873?

A. Yes, sir.

Q. 17. Will you please produce your diary and point out to the examiner the entry of July 14, 1873, in order that he may copy it upon the record?

A. Yes, sir; here it is. (Witness produces diary containing the following entry:)

"Monday, July 14th, 1873.

"Dickey brought 1 of the Karper steers up from Mills Glen and killed it, and 1 sheep. I went to New Cumberland in early train. Emrick and I got a team and went up to Lisburn and around to Barney Wilder's and got home on the local option train."

By consent the above copy is put in evidence instead of the original; the original to be produced when called for, and said copy to be subject to all legal objections that might be made to the original.

Q. 18. In whose handwriting is that entry in your diary, and when was it entered there?

A. It is mine, and it was entered at that time—likely that time or next morning, as parties make such entries. If when I got home on the local option train it wasn't done then, it was done next morning likely, but it was done by me.

Q. 19. Did Mr. Emrick accompany you on that trip from New Cumberland to Lisburn?

A. Yes, sir.

Q. 20. Was that the same George Emrick who testified here yesterday?

A. Yes.

Q. 21. While you were in Mr. Daniel Drawbaugh's shop that day, what, if anything, took place, besides politics?

A. After we got through politics with Mr. John Drawbaugh, we met Daniel there and had a talk with him, and he commenced talking to us about a talking machine, and showed it to us—one part of it. By "us" I mean Mr. Emrick and I, we were present together.

Q. 22. In what part of the shop were you when Mr. Drawbaugh commenced talking to you about the talking machine?

A. We were on what I call the middle floor, where the turning lathes and iron machinery was. The talking machine that he showed us was not on that floor.

Q. 23. When Mr. Drawbaugh started to show you the talking machine, what did he do?

A. He called on some person up stairs to go to the machine, and he and Mr. Emrick and I went down one flight of stairs into the lower story, as I call it, and went to a window or bench not far from the stairs. He commenced—had a little machine there—and commenced talking.

Q. 24. Was that lower story, as you call it, the basement, where the water wheel was?

A. I think so, sir; it was one story below where we went in; I know that we went in on the middle story.

Q. 25. Describe how Mr. Drawbaugh talked and listened at the machine?

A. He talked into a round box, or something of that kind, standing on its end with its mouth upwards—with a hole upwards, rather—a hole in its upper end. He listened with his ear and talked with his mouth put close to the machine. He stooped down and put it to it.

Q. 26. When he listened with his ear, how close did he put his ear to the machine?

A. Right against the machine—close to it.

Q. 27. Did he talk into, and listen at, the same instrument, or did he have one for talking into and another for listening at?

A. I think there was but one instrument there that was used.

Q. 28. Did you or Mr. Emrick talk into the machine or listen at it?

A. No, sir.

Q. 29. How did you know that the man in the third story answered back, when Mr. Drawbaugh talked into the machine?

A. Only by hearing Mr. Drawbaugh asking questions and telling us what was the answer from above as he said.

Q. 30. Why didn't you have the curiosity to try the machine yourself?

A. Well, I don't know why I didn't. I guess he did ask me, but I was about through and he was a man that did a great deal of talking himself—studying and explaining—Dan. was, explaining the machine and the workings of it.

Q. 31. How was the machine connected with the third story?

A. By a wire, or it started from there with a wire. I don't know where it led to; I wasn't on the third story.

Q. 32. Did Mr. Drawbaugh explain to you the principal on which it operated, or how the sound was communicated over the wire from one end to the other?

Objected to as leading.

A. He was explaining to us about a wire that ran from the machine down below—that it was by electricity that the machine was operating; but I was not paying much attention; I didn't know much about that kind of work.

Q. 33. Did he state how far you could talk through that kind of machine?

A. He said he could talk for miles if he had the wires attached; that it was in running order now.

Q. 34. Was anything said that day about patenting the invention; if so, what?

A. He said he was going to get it patented as soon as he could get some money; that he was looking for some help from some parties to help him to the money.

Q. 35. Did you get the idea from what he said, that he was then expecting some party to provide the money, or go in with him on it?

A. From his conversation, he was looking for some party to raise the money and go in with him and get it patented; he was a man that had no means within himself.

Q. 36. Please look at the instruments "F", "B", "C" and "I", now placed on the table before you, and state whether or not you recognize any of them as the instrument that Mr. Drawbaugh talked into and listened at that day?

A. (Taking up "I"). I would say that that gives me an idea of what I saw that day; but whether it is the identical instrument, or whether any of these are the identical instruments, I can't say; that gives me an idea; it was something like that; it may have been the same one, or it may not have.

Q. 37. Have you ever been in Mr. Drawbaugh's shop since that day; if so, when?

A. I think not; I might have been there when I went to see Mr. John Drawbaugh, a few years ago; but I don't think I was ever inside the establishment since 1873.

Q. 38. Were you ever at the village of Milltown with Mr. George Emrick on any other occasion except that one?

A. No, sir.

Cross-examined by Mr. Storrow:

X-Q. 39. I have a certified copy of a petition to the court, and action thereon, in the case of the commonwealth against Levan H. Orris, as it appears recorded in the records of said case, which I now offer in evidence. It is as follows:

COMMONWEALTH vs. 18 LEVAN H. ORRIS.	Embezzlement. 11th April, 1876. A True Bill. N. E. I.

31st August, 1876, continued.

We, the undersigned, citizens of Cumberland county, respectfully request the Court of Quarter Sessions to permit the District Attorney to enter a *nolle prosequi* in the case of the Commonwealth vs. Levan H. Orris, for the reason that full restitution has been made to the county, and the

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family of the defendant is in great distress, and we believe the ends of justice have been already subserved.

CYRUS MOORE,
SAM'L WOLF,
JOHN DRAWBAUGH,
and 165 others.

And now, 18th January, 1877, leave granted the District Attorney to enter a *nolle prosequi* in this case.

BY THE COURT.

Now, to wit, January 19th, 1877, in accordance with the permission granted by the Court upon the annexed petition in writing, a *nolle prosequi* is entered in this case.

F. E. BELTZHOVER,
District Attorney.

I hereby certify that the foregoing is a true and correct copy of the proceedings in the case of the Commonwealth vs. Levan H. Orris, as it is recorded in Quarter Sessions Docket "R", page 83. In testimony whereof I have hereunto set my hand and affixed the seal of said Court of Quarter Sessions, at Carlisle, this 11th day February, A. D. 1885.

B. K. GOODYEAR,
Depy. Clk. Qr. Sess.

Did you sign that petition?

The alleged copy of the petition objected to as incompetent, irrelevant and immaterial, and the question objected to as immaterial.

A. Yes, sir.

JOHN M. WOODBURN.

Sworn and subscribed to before me this 11th day of February, 1885.

FRED. M. OTT,
Special Examiner.

David Stevenson being produced, affirmed and examined, saith:

Examined by Mr. Hill:

My age is fifty; residence, Mechanicsburg, Cumberland county, Penna.; occupation, machinist.

Q. 1. In the oral argument made by Mr. Storrow for the complainants in the case of the American Bell Telephone Company and others against the People's Telephone Company and others, in the United States Circuit Court for the Southern District of New York, Mr. Storrow made the following statement, as I find in the printed report of his argument, pages 201 and 202, to wit:

"Another witness (I cannot call him a witness in the ordinary sense, for he has not appeared on the stand, but he ought to be called one) was a man named David Stevenson, now a resident of Harrisburg, a machinist. It appeared in the evidence that he kept a machine shop and a machinist's supply shop, and that he worked for and with the Faucet Company, not as a mechanic in their shop, but as a maker of patterns, or in doing work for them in his own machine shop, in 1867 and 1868, and that he and Drawbaugh had many and intimate relations with each other ever since. He has done work for Drawbaugh, and Drawbaugh got up some pumps and a flue cleaner, etc., for him. They appear to have been partners, or jointly engaged in the manufacture of certain pumps and putting them out. He has been and is still a friend of Drawbaugh's, and at the end of this case he turns up as a man hunting witnesses for the defendants and in their employ. Now, here is a machinist, a machine-shop man, a keeper of a machinist's supply store, having intimate relations with Drawbaugh, having worked for him in his shop, and doing work for him in his own—doing work for each other—*quasi* partners, jointly interested in making pumps according to some invention of Drawbaugh's (all this is in Drawbaugh's examination), and in the employ of the defendants at the close of this case. If there was a telephone there, he must have known every-

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thing about it, but they do not put him upon the witness stand. I do not need to argue the importance of that line of conduct. When you come to read the brief, you will find case after case with comments upon the conclusive effect, under such circumstances, of the failure to call a witness by the party upon whom the burden rests, and upon whom a very heavy burden rests. Brief, p. 269."

Are you the David Stevenson referred to by Mr. Storrow in that paragraph?

A. Yes, sir.

Q. 2. How long have you known Daniel Drawbaugh?

A. About twenty-five years, I guess.

Q. 3. So far as you know, what was his financial condition from 1869 to 1880?

A. He always represented to me that he was poor.

Q. 4. If you ever saw his talking-machine, will you tell us where you first saw it, and who showed it to you?

A. I first saw it in what he called the old shop—in what I call the old shop; Mr. Drawbaugh showed it to me, or I saw him operate it; he didn't just show it to me particular.

Q. 5. In what building was that old shop, as you call it?

A. It was on the first floor of the building he occupied as a dwelling-house.

Q. 6. How far was that building from Eberly's grist-mill?

A. It was about forty feet from it.

Q. 7. Was that before or after he moved his shop down into the old clover-mill that he now occupies?

A. I don't know when he moved; he had his work-bench there at the time, in his old shop; for some time he worked back and forward, from one shop to the other, even after he moved.

Q. 8. Was he living in the same house at the time?

A. Yes, sir.

Q. 9. You say he operated the talking-machine for you at that time; how did he operate it?

A. Well, he went into a small room partitioned off from the large room—after that it was all one room—and he first

gave me some instrument to hold in my hand and place to my ear, and he went into the chimney or by the chimney; he had connections there that he spoke through, and I heard the sound faintly.

Q. 10. Through the instrument you held in your hand?

A. Yes, sir.

Q. 11. How were the instruments that you held in your hand and listened at, and that he spoke through, connected?

A. The instrument that I had in my hand, there was a wire connected to; the other instrument I didn't see the connection.

Q. 12. Where did the wire run to from the instrument that you held in your hand, or how did it run?

A. To the instrument I held in my hand, the wire came from the outside of the building, the porch.

Q. 13. How many wires?

A. Mr. Drawbaugh called my attention to it; I went to the window and he showed me a wire running lengthwise of the porch; I don't know; there was more than one; I have the impression that they run zigzag to give length to the wires.

Q. 14. Did Mr. Drawbaugh at that time explain to you or say how the instrument was operated, or what made the sound pass over the wire from one end to the other?

Objected to as leading.

A. He said the power was the power of electricity.

Q. 15. Did you hear any words through the machine at that time?

Same objection.

A. I don't recollect the words; I can't name the words; I heard sounds through it.

Q. 16. Were you ever in Mr. Drawbaugh's shop in company with any of your family?

A. Yes, sir.

Q. 17. Which members of your family?

A. My two daughters.

Q. 18. What did you take them over there for?

A. I went over to the country to gather chestnuts; we

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didn't go direct to his shop, we stopped there on our way home.

Q. 19. In what house were you living at the time when you took your two daughters to Mr. Drawbaugh's shop?

A. I was living in this city at the corner of Third and Chestnut streets.

Q. 20. Did you and your two daughters go from that house that day?

A. Yes, sir.

Q. 21. When did you last live in that house?

A. I moved away from it in August, 1875, about the middle of the month.

Q. 22. How long did you live in that house before you moved away from it.

A. Over three years.

Q. 23. How came you to go into Mr. Drawbaugh's shop that day?

A. Before going in there we stopped at the spring opposite to take lunch; and after lunch I went into the shop and the girls remained there at the spring—remained there until some time about one or two o'clock in the afternoon, whenthey came over the dam to his shop—I think to get fishing rods or something or other—and we all remained in the shop till it became late in the afternoon, so that we had to hurry home to go to Harrisburg before night.

Q. 24. Where was Mr. Drawbaugh's shop at that time?

A. His shop that he uses at the present time.

Q. 25. When you were in his shop that afternoon, while the girls were over at the spring, and before they came into the shop, what were you doing?

A. I don't recollect all the while what we were doing; part of the time we spent at his talking machine, so he termed it.

Q. 26. What were you doing with his talking machine?

A. He, after explaining, sent me to the cellar, or took me to the cellar; I don't recollect which—cellar or ground floor; he then after giving me a small instrument in my hand, said he would go up on to the upper floor again and

would speak to me, and I should let him know what he said, and how distinctly I heard it.

Q. 27. Well, did you do as he told you?

A. I did; I heard him speaking short sentences and singing; I then went upstairs, and met him coming toward me and told him what he said, and that was all that was done.

Q. 28. How plainly and distinctly did you hear his speaking through the machine?

A. I heard him very clear, and I did not miss any words in repeating what he said—excepting the singing; I didn't repeat that.

Q. 29. How did the sounds which you heard through the machine that day compare in loudness and distinctness with the sounds which you heard through the machine in the old shop near the grist mill, as you have testified?

A. With more force and clearness at that last time.

Q. 30. When you held the instrument to the ear in the basement of Drawbaugh's shop, on the day when you and your girls were on that excursion, do you remember how it was connected with the instrument that he talked into on the upper floor?

A. No; I did not follow the line of wire that day. Mr. Drawbaugh had shown me the run of the wire on the third floor and where it ran down, at that time, or previous to that.

Q. 31. In what part of the basement were you standing when you listened at the machine that day?

A. Near the side door or stairway.

Q. 32. That was the end opposite to the end where the water-wheel, was it not?

A. Yes, sir; on the same side of the building, but at the opposite end.

Q. 33. Where was the machine on the upper floor at that time?

A. The machine or transmitter was about the window at the east side of the building in a small room.

Q. 34. How long did you and Mr. Drawbaugh operate the machine that day before the girls came over?

A. Not very long; he seemed to want to show me the improvement he had made; that was all. I paid no more attention to it the balance of the day.

Q. 35. While you and Drawbaugh were talking through the machines that day, do you remember whether the mill machinery was running or still?

A. I don't recollect, at that time, whether it was running or not.

Q. 36. Were you ever in the basement of that mill when the machinery was running?

A. Yes, sir.

Q. 37. What machinery was there down in the basement connected with the running of the mill?

A. The water-wheel and upright shaft to it, and countershaft and pulleys communicating power to the line shaft above. They kept castings there; it was their store-house for their castings.

Q. 38. What kind of a water-wheel was it?

A. It was a wood wheel made by Drawbaugh on the turbine principle.

Q. 39. Was it boxed?

A. It was boxed around, and then there was some loose boards over that again—a sort of a crib work?

Q. 40. Did the wheel run under water?

A. I rather think it was just above the surface of the water—center discharged.

Q. 41. Did the water-wheel, upright shaft and countershaft make much, or little noise in the building when running?

A. At the water-wheel end of the building there was noise from the wheel and the running of the gearing.

Q. 42. How about the opposite end of the basement, where you listened at the talking-machine that day?

A. At that end of the building the noise didn't amount to much.

Q. 43. Did you ever listen to a talking-machine in that basement when the water-wheel was running?

A. I don't recollect whether I did or not.

Q. 44. When the girls came over to the shop that afternoon what did they do?

A. I wasn't with them much through the shop, Mr. Drawbaugh was explaining his talking machine to them and interesting them in it.

Q. 45. Do you know whether they talked through it that day, or whether he talked through it to them?

Objected to as calling for hearsay and guesswork.

A. I don't recollect how it was—whether they talked through it or not—but he explained it to them. I didn't see what they were doing, but they told me he did. They told me they talked through it.

Q. 46. You have now narrated two occasions when you saw Mr. Drawbaugh's talking machine, and he talked to you through it, to wit: at his old shop near the girst-mill, and the other in the clover-mill which he now occupies; did you ever see his talking machine at any other time; and if so, how often?

A. I seen it other times frequently; I don't know how often.

Q. 47. Did you ever have any talk with Mrs. Drawbaugh about her husband's talking machine or his work on it; and if so, when was it, and what did she say?

Objected to as calling for hearsay.

A. When they lived in the old house near the grist-mill she more than once asked me to try to get his attention off that talking machine; she said she was afraid it would derange his mind.

Q. 48. Did she say anything about how much he worked on it, or what effect it had on him?

Same objection.

A. She said he lost a great deal of sleep by working on it at night, as late as one and two o'clock in the morning,

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and that she couldn't get him to his meals, and had to wait on him sometimes one or two hours.

Q. 49. Did you say anything to him to get his attention off the talking machine, as she requested?

Same objection.

A. No, I did not.

Q. 50. You say that she made this request of you when they were living in the old house near the grist-mill; how long ago was that?

A. I don't know.

Q. 51. He lived in that old house twice; the first time, prior to the beginning of the year 1869, and the second time from the 1st of April, 1877, till some time in 1881 or 1882; was it during their first term of living in that house, or during their second term that she made that request of you?

Objected to as leading, and because the memory of the witness has already been exhausted.

A. It was during their first term.

Q. 52. Did you take much or little interest in Drawbaugh's talking machines, as he showed them to you from time to time?

A. Very little interest, or none.

Q. 53. Do you remember anything that you said to him about your interest in them, as he spoke to you about them from time to time?

A. I do recollect of telling him that I didn't understand anything about electricity and didn't have time to give it attention, and I didn't want him to waste his time trying to explain it to me; I didn't want him to waste his time that way.

Q. 54. Please look at the instruments marked "F", "B", "C reproduced", "I", "A", "D", "E", "G", "O", "L", and "M" now placed on the table before you, and state how far you remember them or any of them, and whether you are able to pick out any one or ones as the machines that were operated in your presence in the old

shop near the grist mill, or in the other shop in the clover mill?

A. The machines are familiar to me, but I can't say where they were operated. The one there with the horse-shoe magnet behind it (indicating "C reproduced") I have seen frequently, or a machine similar to it, with a horse-shoe magnet. The one with the glass I don't remember of ever seeing before. This rude machine here (indicating "B") compares with the first machine I saw in rudeness, but I can't say as to shape any more. The first instrument was a very rude instrument that I saw.

Q. 55. Are you able to pick out any of these machines as the machine you operated in the basement the day your girls were there?

A. No, sir; I am not.

Q. 56. Do you remember anything about the shape or appearance of the instrument that you listened at that day?

A. No, sir; I do not.

Q. 57. Did Mr. Drawbaugh ever show you a line of wire running from this shop out to a fence?

Objected to as leading.

A. Yes; he did.

Q. 58. Do you remember when that was?

A. I don't know the date; it was from the shop he is in at the present time.

Q. 59. What kind of a fence was it that the wire ran to?

A. I seen it from the shop window; he showed it to me. The wire ran from the window to two or three posts, and then to the fence that run along the creek. He told me there was about three thousand feet of wire there—and in the coil; it appears it wasn't all on the fence.

Q. 60. Did you ever look up any witnesses for the Drawbaugh party in their suit with the Bell party?

A. Not directly. I went with Mr. Chellis to gain information for him in that direction—or for the company.

Q. 61. How many times did you go and how much time did you spend in that employment.

A. I don't recollect. I gave Mr. Chellis a bill of my

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time and expenses amounting to twenty dollars or thereabouts.

Q. 62. That was all the work you did for the company, was it?

A. Yes, sir; I wasn't employed by the company. They just merely paid me for my time on account of the information I gave them—time and expenses.

Q. 63. About the time when the suit was brought against the Drawbaugh party by the Bell party, or not long thereafter, did Mr. Drawbaugh come to see you about your recollection of his talking-machine?

Objected to as immaterial.

A. I don't know that he came to see me; he met me and asked me whether I wouldn't give my evidence in regard to it.

Q. 64. What did you say to him?

A. I told him that I was with him a good deal in the telephone work, but that I couldn't give him any dates positively.

Q. 65. And after that did Mr. John C. Comfort come to see you about your knowledge of Drawbaugh's talking-machine?

A. I met Mr. John C. Comfort—I don't know whether it was before that time or after, at Shiremanstown—it was after—he drove me here from Shiremanstown in a sleigh, and on the way he asked me questions about the telephone business; and I told him I could do him no good; that if I could recollect dates I would be a good witness for Dan.

Q. 66. About how long ago was it that you had this conversation with Mr. Comfort?

A. It was in the winter two years ago, or three years ago—two years ago I think.

Recess until 8 P. M.

Cross-examined by Mr. Storrow:

X-Q. 67. How long have you lived in Mechanicsburg?

A. Since last May.

X-Q. 68. Where did you live before that?

A. In this city—Harrisburg—on Fourth street.

X-Q. 69. How long did you live on Fourth street?

A. I lived there two years and one month.

X-Q. 70. How long did you live in Harrisburg before you went to Mechanicsburg?

A. About twelve years—since 1871.

X-Q. 71. Where did you live before 1871?

A. I lived two years at Bridgeport on the opposite side of the river from here.

X-Q. 72. Where before that?

A. I lived, before that, in this city, in Aberdeen avenue, about two years.

X-Q. 73. What is your occupation at the present time?

A. I am a machinist by trade, and selling machinery.

X-Q. 74. What machinery are you selling?

A. Appliances to steam engines and boilers.

X-Q. 75. How long have you been doing that?

A. About fifteen years.

X-Q. 76. Is selling appliances for steam engines and boilers all the work that you have done for the last fifteen years; is that what you mean?

A. That is not all I have done; no, sir.

X-Q. 77. When did you last do any work in a machine shop, either as foreman or as machinist?

A. The last business I had in the shop was in 1868; I was then a partner with Jennings and Stover; since then I have been selling machinery and putting it up for other parties.

X-Q. 78. What machinery have you sold and put up for other parties within the last five years?

Objected to as immaterial and irrelevant.

A. I couldn't enumerate all I have sold in that time; in that time I have been keeping a supply store and selling supplies, and have bought and sold machinery.

X-Q. 79. Enumerate some of the people whose machinery you have sold within the last five years?

Same objection.

A. I have bought and sold Frick & Co.'s machinery,

Waynesborough; Heald & Morris', Baldwinsville, N. Y.; and have got boilers from Potts Bros., Lebanon, and bought and sold them; and appliances I have had from various manufacturers, mostly patented articles that I have bought and sold.

X-Q. 80. Name some of those patented articles.

Same objection.

A. The Allen Governor, from the Allen Governor Co., Boston; the Pickering Patent Governor, from the Pickering Governor Co., Portland, Conn.

X-Q. 81. Please name some more.

Same objection.

A. I have been selling a patent steam heating boiler for the Mount Joy Steam Heating Co.; and the Hancock Inspirator, for the Hancock Inspirator Co., Boston.

X-Q. 82. In your deposition you have mentioned Mr. E. W. Chellis, of Harrisburg; you have had some business with him, also, during the last five or six years, have you not?

A. The last two or three years I have sold some of his Water Motors—the Drawbaugh Water Motor.

X-Q. 83. Daniel Drawbaugh's Water Motor?

A. It is called the Drawbaugh Patent Water Motor.

X-Q. 84. Daniel Drawbaugh's patent, or some other Drawbaugh?

A. Daniel Drawbaugh's patent; the machine I mean is lettered: "The Drawbaugh Water Motor."

X-Q. 85. Where is it manufactured?

Same objection.

A. It was manufactured at Drawbaugh's present shop.

X-Q. 86. Where is it manufactured now?

Same objection.

A. It has not been manufactured lately, to my knowledge, nor at any other place.

X-Q. 87. You have had something to do on them, or about them, at a machine shop in this city within the last three years, have you not?

Same objection.

A. I have, in changing patterns, but not in manufacturing machines; I have attended to having alterations made in patterns.

X-Q. 88. You spoke of a gearing in the basement of Drawbaugh's shop; what was that gearing?

A. It was a gearing to communicate motion from the upright water-wheel shaft to the horizontal or countershaft.

X-Q. 89. So that all the power of the wheel passed through that gearing?

A. Yes, sir; I believe it is geared in that way; I don't know of any other shaft or gearing connected to that upright wheel shaft.

X-Q. 90. Beveled gearing, I suppose.

A. Yes, sir; but whether it is tooth gearing or cog gearing I don't know; I rather think it is gog gearing.

D. STEVENSON.

Sworn and subscribed to before me this 11th day of February, 1885.

FRED. M. OTT,
Special Examiner.

March 12, 1885.

David Stevenson recalled.

Examined by Mr. Hill:

Q. 1. When you lived in the house on the corner of Third and Chestnut streets, Harrisburg, to whom did you pay the rent for that house during the last year or two that you lived there?

A. To Theodore P. Garman.

Q. 2. When you moved from there into the house No. 1020 Market street, to whom did you pay the rent for this house on Market street?

A. The first four months I paid it to William and Andrew Potts; after that, to their father, Joseph R. Potts; I generally settled with the boys William and Andrew, but when I gave checks I made them payable to their father.

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Q. 3. Have you any original writings here present that enable you to fix the date of your payments of rent to Mr. Garman and to the Messrs. Potts?

A. I have receipts from Mr. Garman, with the exception of the last two months, and a check-stub showing a settlement for the last two months—July and August; I have the book here showing the account with Mr. Potts for the four months from the first of September, 1875, to the first of January, 1876.

(Witness produces a stub-book and an account book.)

Q. 4. In whose handwriting are these entries in the stub-book and the account book?

A. Mine.

Q. 5. Referring to the stub-book which you have produced, it appears to be the stub part of a check book from which the checks have been torn out; is it such?

A. Yes, sir.

Q. 6. And in the numbered blanks on the stubs there are a series of entries in writing which are apparently memoranda of checks given at different times; is such the fact?

A. Yes, sir.

Q. 7. When were these memoranda made on these stub leaves?

A. At the same time the checks were filled.

Q. 8. I call your attention to one of these entries in the stub-book, which is as follows:

"No. 270.

Date, March 6th, 1875.

T. P. Garman.

Rent to 1st of April, $62\frac{50}{100}$."

And I ask you if you issued a check to Mr. Garman at that date for that amount of rent?

A. Yes, sir.

Q. 9. What property was that rent paid out?

A. Property at the corner of Third and Chestnut streets.

Q. 10. I call your attention to another entry in this stub-book, which is as follows:

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"No. 288.
Date, May 25, 1875.
T. P. Garman.
Store bill full, - - $8.43
3 mo. rent to 1st of July, 62.50

70.93"

And I ask you if you issued a check to Mr. Garman on that date for 70.93 of which 62.50 were for rent to July 1st?

A. Yes, sir.

Q. 11. For what property was that rent paid?

A. Property at Third and Chestnut.

Q. 12. I call your attention to another entry in the same stub-book, which is as follow:

"No. 303.
Date, Aug. 10, 1875.
T. P. Garman.
In full rent to 1st September, 1875, 30\frac{\text{X}}{\text{100}}$."

And I ask you if you issued a check on that date to Mr. Garman for $30. for rent to 1st September, 1875?

A. I did.

Q. 13. In this last mentioned check stub I find the words "*in full*" rent to 1st September, 1875, which words "in full" I do not find in the rent stubs previously referred to. State, if you know, why those words "in full" were embodied in this entry of August 10, 1875?

A. It was for the last payment I had to make—a final settlement.

Q. 14. Was this also for rent of the property at the corner of Chestnut and Third streets?

A. Yes, sir.

Q. 15. Referring now to the account book which you have produced, I find therein the following entry:

"1875, W. & A. Potts, Dr.

May 8,	To 61 ft. 1¼ pipe	19 - - -	$10.44
	" 1—1¼ socket - - - - -		17
	" cutting 4 threads - - - -		68

" 3—1¼ sockets - - - - - - 51
Aug. 14, To 6 water sinks and
6 compression cocks - - - 30.00
" 19, " 2 hours drilling holes - - - 60
Nov. 1, Bill of G. Oglesby - - - - 5.75

$48.00

Contra Cr.

By 4 months' rent of house from 1st Sep. to 1st Jan., 1876, at $12 per month, - - - $48.00"

And I ask you what property this charge for rent from 1st September to 1st January, relates to?

A. Property of the Potts Bros., No 1020 Market street.

Q. 16. Did you live in that property during the four months referred to in that last mentioned account in your account-book?

A. Yes, sir.

Q. 17. You appear to have paid your first four months' rent on that property by a settlement of an account current with W. and A. Potts; is that the fact?

A. Yes, sir.

Q. 18. Referring now again to your check stub-book, I find an entry therein, as follows:

"No. 318.
Date, Feb. 27, 1876.
J. R. Potts.
Coal - - - - - 9.00
Cash - - - - - 27.00
——$36.00 Rent."

Did you issue a check to Mr. Potts on that date for $27, on a rent account of $36?

A. Yes, sir.

Q. 19. On what property was that payment of rent made?

A. The same property, No. 1020 Market street.

Q. 20, In the same check stub-book I find another entry as follows:

"No. 338.
Date, May 10, 1876.

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J. Potts.

Rent 1st April to 1st July, $31.17."

Did you issue a check on that date, as indicated by that stub; and if so, on what property was that rent paid?

A. Yes, sir; on the same property, 1020 Market street.

Q. 21. In the same stub check-book I find another entry as follows:

"No. 356.

Date, Aug. 18, 1876.

J. R. Potts.

Rent 1st July to 1st Oct., '76, 1 quarter, $42\frac{x}{100}$.

Did you issue a check on that day, as indicated in that stub; and if so, as rent on what property?

A. Yes, sir; the property 1020 Market street.

Cross-examination by Mr. Howson:

X-Q. 22. How much older than your daughter Florence is your daughter Alice?

A. About five years is the difference in their age.

D. STEVENSON, JR.

Subscribed to before me this 12th day of March, 1885, he having been previously sworn.

FRED. M. OTT,
Special Examiner.

Adjourned to meet March 13th, 1885, at the Colonnade Hotel, Philadelphia, at 2 P. M.

George W. Longenecker being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is forty-nine; residence, Marysville, Perry county, Penna.; occupation, farming.

Q. 1. Were you at the Centennial Exposition at Philadelphia, in 1876?

A. Yes, sir.

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Q. 2. In what month of the year were you there?

A. It was in September—I think, the latter part of it.

Q. 3. Do you know Daniel Drawbaugh, of Eberly's Mill's, Cumberland county?

A. Yes, sir.

Q. 4. Were you ever in his shop at Eberly's Mills or Milltown?

A. Yes, sir.

Q. 5. How many times were you ever in his shop, in your life?

A. I was there but once.

Q. 6. Was that before, or after your visit to the Centennial?

Objected to as a leading and improper mode of inquiry, and as asking for guess-work.

A. It was before.

Q. 7. How certain are you that it was before you went to the Centennial?

A. I am positive of that, because I wasn't in Milltown after that, until I moved there.

Q. 8. Were you at Milltown after that?

A. After I had been to the Centennial.

Q. 9. You say that you moved to Milltown, how long did you live at Milltown?

A. One year.

Q. 10. Where did you live at Milltown?

A. I lived in Mr. Best's house; it is not right in the town, but on a farm outside of the town.

Q. 11. Where did you move to when you moved away from Mr. Best's farm?

A. To Boyer's place.

Q. 12. Where is that?

A. It is on what we call the mountain road—a road back of the State road near the Blue Ridge mountains.

Q. 13. How long did you live on Boyer's place?

A. Two years.

Q. 14. Where did you move from there?

A. I moved to Fairview then from there.

Q. 15. How long did you live in Fairview?

A. For one year.

Q. 16. Where did you move to from there?

A. I moved on to Shaffer's farm.

Q. 17. How long did you live there?

A. One year.

Q. 18. Where did you move from Mr. Shaffer's farm?

A. I then moved on to Mr. School's farm, where I live now.

Q. 19. When did you move on to Mr. School's farm?

A. Last spring—I believe it was on the first of April, 1884.

Q. 20. Do you remember what season of the year it was when you were in Mr. Drawbaugh's shop?

A. I think it was in May, or some time in the spring.

Q. 21. What was going on in Mr. Drawbaugh's shop the day you were there?

A. Mr. Drawbaugh and another man were in the shop; I didn't see anything particular that they were doing.

Q. 22. Did Mr. Drawbaugh show you anything in the shop that day?

A. Yes, sir.

Q. 23. What was it?

A. He showed us two small boxes, and called them a talking machine.

Q. 24. About what size and shape were the boxes?

A. Well, they were two round boxes, may be two inches and a half in diameter; they might have been a little more, and perhaps not so much.

Q. 25. Were they of wood or metal?

A. They were wooden boxes.

Q. 26. Do you remember anything peculiar about them?

A. Well, I don't know that I do—anything particularly peculiar.

Q. 27. Was there any metal about the boxes?

Objected to as leading, and because the witness' memory on the subject has already been exhausted.

A. Yes sir; on the one there was.

Q. 28. What kind of metal?

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A. Well, that I don't know; it was iron of some kind.

Q. 29. What was the shape of that iron?

A. Well, it was on the end of the box; the shape I couldn't exactly give you, I believe.

Q. 30. Give it as near as you can?

Objected to, the witness' recollection having been exhausted on the subject.

A. Well, it wasn't a round iron; but I really can't give you the shape of it.

Q. 31. Do you mean that you don't remember it, or can't describe it?

Objected to as leading and improper.

A. I don't know that I can describe it exactly.

Q. 32. Please look at the instruments "A", "D", "E", "G", "O", "L", "M", "N", and "Q", now placed on the table before you, and see whether you do or do not recognize among them the instruments you saw at Mr. Drawbaugh's shop that day?

Objected to on the ground that no sufficient foundation has been laid for the question.

A. I think these are the two (taking up "P" and "E"); they were round boxes something like them.

Adjourned until Feb. 12, 1885, at 10 A. M.

G. M. LONGENECKER.

Sworn and subscribed to before me this 12th day of February, 1885.

FRED. M. OTT,
Special Examiner.

February 12th, 1885, 10 A. M.

Mr. Hawson having been called away from Harrisburg during last night, on account of the serious illness of his father, and neither Mr. Storrow nor other counsel for complainants being in the city, the examination of George W. Longenecker is suspended for the present, he signing his deposition as a precautionary measure; and further taking of testimony at Harrisburg is also suspended for the present, in

accordance with a verbal arrangement between Mr. Hawson and Mr. Hill, to be resumed during such extension of time as may hereafter be agreed upon between said counsel; in the meantime the deposition of Professor Barker to be resumed at the Colonnade Hotel, Philadelphia, on Friday, February 13, 1885, at 10 A. M.

FRED. M. OTT,
Special Examiner.

PHILADELPHIA, February 13, 1885.

Present: Mr. Hill for respondents. Mr. Hawson being unable to attend on account of the death of his father, and no other counsel for complainants being present, the taking of testimony is adjourned until further notice.

FRED. M. OTT,,
Special Examiner.

HARRISBURG, March 4th, 1885, 3 P. M.

Examination resumed pursuant to notice.

Present: Mr. Hawson for complainants, and Mr. Hill and Mr. Jacobs for respondents.

George W. Longenecker recalled.

Examined by Mr. Hill:

Q. 1. Please look at the two instruments "D" and "E" carefully, and at the curved iron on the back of instrument "D", and state how closely these boxes resemble the boxes which you saw at Drawbaugh's shop, as you have already testified; and also state how the iron on the end of the instrument "D" compares with the iron on the end of the box which you saw at Drawbaugh's shop?

Objected to as a leading and improper mode of inquiry, and as especially incompetent in view of the preceding answers of the witness.

A. Well, so near as I can say, they look exactly like the boxes I saw at Drawbaugh's shop; the iron on this box is as near as anything I could compare to it.

Q. 2. Did you talk through the machines that day or did anybody talk to you through them?

Objected to as leading.

A. No, sir.

Q. 3. Did Mr. Drawbaugh make any statement to you, that day, as to what the machines could do, or how they worked; if so, what did he say?

Objected to as leading and incompetent.

A. He was telling that this was a talking machine, and that he could talk from his place to a certain town that he mentioned—I don't know whether it was Mechanicsburg or Carlisle—somewhere in Cumberland; he then spoke of this machine working by electricity, or was worked by electricity; but a great many people, or the half of the people, didn't know what electricity meant.

Q. 4. Was there anything said there that day in regard to patenting the invention?

Objected to as leading.

A. Mr. Drawbaugh said that he would have had this thing patented before this had he not been too poor, or would have had the money, something of that kind; these may not be just the words he used, but something to that effect; that is, so far as being too poor; I am satisfied he said that, and something concerning the money.

Answer objected to by Mr. Howson as not evidence.

Cross-examined by Mr. Howson:

X-Q. 5. You say that you are living in Marysville, Perry county, on a farm which you call Mr. School's farm, and that you have been living there since the 1st of April, 1884; is not that the farm close by Marysville, which was formerly known as the Draper farm, and was at one time occupied by Mr. George W. Kissinger?

A. They tell me so, but I don't know; I know it was called the Draper farm; that is, it was talked so.

X-Q. 6. You say that you lived for one year in Mr. Best's house just outside the village of Milltown; what year was that?

Objected to, because the witness' previous testimony shows where he lived in the different years after moving from Mr. Best's farm, and that fixes the time he lived on Mr. Best's farm.

A. I think it was in the year 1880, as near as I can say.

GEORGE W. LONGENECKER.

Sworn and subscribed to before me this 4th day of March, 1885.

FRED. M. OTT,
Special Examiner.

Recess until 3 P. M.

John H. Snyder being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is thirty-four; residence Newville, Cumberland county, Penna.; occupation, manufacturer of brick.

Q. 1. What was your father's name?

A. Henry Snyder.

Q. 2. Is he living, or dead; and if the latter, when did he die?

A. He is dead; he died on the 10th day of Dec., 1883.

Q. 3. Where did he live for many years prior to his decease, and in what business was he engaged?

A. At Jacksonville, about five miles from Newville, Cumberland county, Pa.; he was engaged in the grain business; he was engaged in business at Newville, and then he went to Jacksonville.

Q. 4. While he was engaged in this business at Newville, did he have a warehouse there; and if so, where was it?

A. Yes, sir; it was near the Cumberland valley depot.

Q. 5. Your father, before his decease, testified as a witness in the suit of the American Bell Telephone Company and others, against the People's Telephone Company and others, in the U. S. Circuit Court for the Southern District

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of New York, stating that at one time he was offered a half interest in Daniel Drawbaugh's talking machine invention, on condition that he would furnish the money to patent the invention and manufacture and introduce the machines; did you know anything about his being offered an interest in that invention?

Objected to as leading and incompetent.

A. Yes, sir.

Q. 6. Are you able to fix the year when he was offered that interest?

A. Yes, sir.

Q. 7. In what year was it?

A. 1873.

Q. 8. In what season of the year?

A. It was that summer.

Q. 9. How do you fix the time?

A. I had a sale in the spring of 1873, on the 19th of March; after the sale, in June sometime, I came into the warehouse and took charge of the books there; and while I was there that summer, Mr. Drawbaugh and father had a conversation on the platform in front of the warehouse; while they were talking there I heard Mr. Drawbaugh say that he had a talking machine.

Answer objected to by Mr. Howson as hearsay, not evidence.

Q. 10. How near were you to them, and how were they and you situated, so that you could hear them?

Objected to as leading and assuming.

A. I suppose I wasn't over ten feet; I was sitting at the open window of the office; they were sitting on the platform outside of the window.

Q. 11. Did you listen to the whole of their conversation or not?

Objected to as leading.

A. No, sir.

Q. 12. If you heard Mr. Drawbaugh on that occasion make any statement to your father in regard to his talking machine, will you please relate what it was?

Objected to as calling for hearsay.

A. Yes, sir; he asked father what he thought of the machine; that he could put it up and talk to him from there out to his farm, and understand what he said.

Q. 13. How far was that warehouse where they were conversing, from his farm to which they referred?

A. Five miles; we call it five miles.

Q. 14. In that part of the conversation between them which you heard, did you hear anything said about your father's taking an interest in the invention?

Same objection as to question 12.

A. Not in that conversation between father and Drawbaugh.

Q. 15. When did you hear about his wanting your father to take an interest in the invention; and who told you?

Objected to as assuming and calling for hearsay.

A. Father came into the office shortly after he was through with the conversation with Drawbaugh, and told me that Mr. Drawbaugh wanted him to take an interest; he was to furnish him some money.

Answer objected to by Mr. Howson as hearsay, not evidence.

Q. 16. Your father, in his testimony, mentioned several interviews with Henry F. Drawbaugh on that subject, but he did not mention any interview with Daniel Drawbaugh; how certain are you that it was Daniel Drawbaugh who had the conversation with your father, a part of which you overheard, that day?

Objected to as leading and incompetent.

A. I am positive it was him.

Q. 17. Have you any paper here that will fix the date of your sale to which you have above referred?

A. I have the conditions of sale and the list of the articles sold.

Q. 18. Will you please produce the conditions of sale, in order that the paper may be copied upon the record?

A. Yes, sir; here it is.

(Witness produces paper.)

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Q. 19. In whose handwriting is this paper?

A. It is father's handwriting; that is his signature of my name, too.

Q. 20. Is that the original paper that was used at the sale?

A. Yes, sir; that is the paper that was used at the sale.

The original paper is put in evidence to be marked "Exhibit Synder Sale," and is as follows:

Exhibit, Snyder Sale.

CONDITIONS.

The conditions of this present public sale, held this nineteenth day of March, 1873, to be as follows, viz.:

The highest and best bidder to be the buyer. All persons buying goods to the amount of *five dollars* and under to pay *cash*. And any person purchasing goods to any amount exceeding *five dollars*, to have a credit of ten months from this date by giving his or their notes with approved security.

No goods to be removed until the above conditions are fully complied with.

Given from my hand this 19th day of March, 1873.

JOHN HARPER SNYDER.

Mifflin Township.

Q. 21. What business had you been engaged in last, up to the time of this sale?

A. Farming.

Q. 22. What was your next employment after the sale?

A. My next employment after the sale was, I planted two orchards on the farm. Directly after that I went into the warehouse, as I have stated already.

Q. 23. Was that your first employment in the warehouse?

A. Yes, sir.

Q. 24. How certain are you that the conversation that you overheard, in part, between your father and Mr. Drawbaugh occurred during that summer of 1873?

A. I am positive it was that summer.

Cross-examined by Mr. Howson:

X-Q. 25. How long have you been making brick?

A. I have been three years, in the spring.

X-Q. 26. Carrying the business on at one place all that time?

A. Yes, sir.

X-Q. 27. At or near Newville?

A. Yes, sir.

X-Q. 28. And you have been living at Newville during the past three years?

A. Yes, sir; it will be three years in the spring.

X-Q. 29. What were you doing immediately before you went into the brick making?

A. I farmed one year—the year before.

X-Q. 30. Where were you farming that year?

A. In Mifflin township, Cumberland county.

X-Q. 31. That was the same township you were farming in before 1873, as you have stated?

A. Yes, sir.

X-Q. 32. During the three years or thereabouts that you have been carrying on the brick business, have you been carrying on business alone, or have you been associated with any one in the business during any part of the time?

A. I have been carrying it on alone.

X-Q. 33. About how far is this Mifflin township farm that you occupied for a year before going into brick making, from Newville?

A. Five miles—we call it five miles.

X-Q. 34. And from Jacksonville, where your father lived before his death, how far?

A. Ten miles.

X-Q. 35. What business were you engaged in immediately before the last time that you were farming?

A. Storekeeping.

X-Q. 36. Whereabouts, and how long?

A. In Mifflin township, on this same farm where I was farming; there is a store house on it; I think I went to

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storekeeping in the spring of 1878, and quit in the spring 1881.

JOHN H. SNYDER.

Sworn and subscribed to before me this 4th day of March, 1885.

FRED. M. OTT,
Special Examiner.

March 5th, 1885, 10.30 A. M.

Examination resumed.

Present: Same counsel.

Alice M. Stevenson being produced, affirmed and examined, saith:

My right name is Mary Alice Stevenson, but I usually write it "Alice M."; the family call me Alice; I reside in Mechanicsburg, and am a daughter of David Stevenson, who was examined as a witness in this case a short time ago.

Q. 1. Do you know Daniel Drawbraugh of Eberly's Mills, Cumberland county, Pa.?

A. Yes, sir.

Q. 2. Were you ever in his shop at Eberly's Mills, or Milltown?

A. Yes, sir.

Q. 3. How happened you to go there the first time that you were ever there?

A. I was chestnutting with my father and sister, and went there during the afternoon.

Q. 4. Were you living with your father's family at the time you made that trip to Milltown, or Eberly's Mills?

A. Yes, sir.

Q. 5. In what house was your father living at the time when you made that trip?

A. At the corner of Third and Chestnut streets, Harrisburg.

Q. 6. From what house did you, your father and sister start on that expedition?

A. From the house at the corner of Third and Chestnut streets.

Q. 7. How did you get to Milltown on that occasion?

A. We went to New Cumberland in the cars, and walked to Milltown from New Cumberland.

Q. 8. Did you take any lunch that day; and if so, where did you eat your lunch?

A. We ate our lunch at the spring, across from Mr. Drawbaugh's shop.

Q. 9. What did you do after you ate your lunch?

A. We went into Mr. Drawbaugh's shop.

Q. 10. How long did you stay in Mr. Drawbaugh's shop that day?

A. We spent the remainder of the afternoon there, until it was time to come home.

Q. 11. How did you get home that day from Mr. Drawbaugh's shop?

A. We walked to Bridgeport, and came across the railroad bridge on a shifting engine.

Q. 12. When the engineer brought you across the river on his engine that day, what point did he land you from the engine?

A. At the corner of Third and Mulberry streets.

Q. 13. Why did he land you at that point?

A. Because it was nearer to our home at Third and Chestnut streets.

Q. 14. How far was it from your home at Third and Chestnut?

A. One square.

Q. 15. Had you ever ridden on a locomotive before?

A. No, sir.

Q. 16. Do you know in what year your father moved away from that house at the corner of Third and Chestnut streets?

A. 1875.

Q. 17. About what time of the year?

A. The latter part of August.

Q. 18. What house did he move his family into when he

moved away from that house at the corner of Third and Chestnut streets?

A. 1020 East Market street.

Q. 19. How far is the house 1020 East Market street from the house at the corner of Third and Chestnut streets?

A. I think it is about five or six blocks.

Q. 20. Did you attend the Centennial Exposition at Philadelphia in 1876?

A. Yes, sir.

Q. 21. Do you remember what house your father's family were living in, when you went to and returned from the Centennial Exposition?

A. At our house No. 1020 East Market street.

Q. 22. Do you remember how many years your father lived in that house No. 1020 East Market street?

A. Six years and a half.

Q. 23. Where did he move to when he moved away from No. 1020 East Market street?

A. No. 7 North Fourth street.

Q. 24. How long did he live at No. 7 North Fourth street?

A. Two years.

Q. 25. Where did he then move to?

A. Mechanicsburg.

Q. 26. When did he move to Mechanicsburg?

A. In May, 1884.

Q. 27. What is your sister's name who was with you on that trip to Drawbaugh's shop?

A. Florence.

Q. 28. Is she older or younger than you?

A. Younger.

Q. 29. How did you spend your time at Mr. Drawbaugh's shop, that afternoon after lunching at the spring, as you have testified?

A. We were running through the shop admiring his drawings, looking at his clock, and talking through his telephone or talking machine, as he called it.

Q. 30. Was Mr. Drawbaugh there with you?

A. Yes, sir.

Q. 31. Who talked through the talking machine there that day, and who listened at it?

Objected to as assuming.

A. Mr. Drawbaugh talked through it, and my sister and I both listening; and we talked through it also.

Q. 32. On what floor of the shop were you when you were talking into and listening at the talking machine that day?

A. On the second floor.

Q. 33. Do you know where your sister was when she was listening at it that day?

A. She was in the basement.

Q. 34. Where was Mr. Drawbaugh while you were talking into the talking machine and listening at it that day?

A. He was on the second floor.

Q. 35. Who did the first talking through the machine that day while you were there?

A. Mr. Drawbaugh spoke to my sister.

Q. 36. Do you remember anything that he said to your sister through the machine?

Objected to as incompetent.

A. I remember his first saying "Helloa!" to her, and asking her if she heard him.

Q. 37. How soon after Mr. Drawbaugh and your sister talked together through the machine, did you and your sister talk together through it?

Objected to as leading and assuming.

A. Immediately afterwards.

Q. 38. Do you remember anything that you and your sister said to each other through the machine that day?

A. No, sir.

Q. 39. Of you and your sister, who spoke first through the machine—you to your sister, or she to you?

Objected to as assuming.

A. I don't remember.

Q. 40. Did you, while talking through the machine with your sister, use the same instrument to talk into and listen

at, or did you have one instrument to talk into to your sister and another one to listen at, to hear what she said?

Objection continued.

A. I don't remember anything about the instruments. I can't describe them at all.

Q. 41. When you listened at the machine to hear what your sister said, what did you hear, if anything, through the machine?

Objection continued, and also objected to because the witness' memory has already been exhausted.

A. I heard my sister's voice, but don't remember what she said.

Q. 42. Did you understand at the time what she said, or not?

Objected to as leading and incompetent.

A. Yes, sir.

Q. 43. How distinctly and plainly did you hear and understand what she said through the machine?

Objections continued.

A. I understood her distinctly, because I spoke to her back again.

Q. 44. When you spoke to her through the machine, did she answer you back as though she heard and understood what you said, or not?

Objections continued.

A. I can't say positively.

Q. 45. But if I understand you correctly, you are positive that you distinctly heard and understood what she said through the machine, and that you answered her back through the machine; are you?

Objections continued.

A. Yes, sir.

Q. 46. Will you tell us whether or not you were ever again in Mr. Drawbaugh's shop after that visit, and before the beginning of the suit over Mr. Drawbaugh's telephone in the fall of 1880?

A. No, sir; I was not.

Cross-examined by Mr. Howson:

X-Q. 47. Are you engaged in any occupation at the present time?

A. No, sir.

X-Q. 48. Have you been so at any time, and if so, where and during what period of time?

A. I was last employed last spring in Philadelphia, dress-making.

X-Q. 49. Have you at any time been engaged at any occupation in this city of Harrisburg; and if yes, where and when?

A. I was employed at the ninety-nine cent store for a year; I went in the winter of 1881 when we were living on Market street yet; I think it was in November—some time before the holidays.

X-Q. 50. The ninety-nine cent store to which you refer was at that time operated by Mr. Edgar W. Chellis, was it not?

A. Yes, sir.

X-Q. 51. When were you last in Mr. Drawbaugh's shop?

A. I don't remember; I was there two or three years ago.

ALICE M. STEVENSON.

Affirmed and subscribed to before me this 5th day of March, 1885.

FRED. M. OTT,
Special Examiner.

Florence A. Stevenson being produced, affirmed and examined, saith:

Examined by Mr. Hill:

My age is nineteen; residence, Mechanicsburg, Cumberland county, Penna.; I am a daughter of David Stevenson, who was recently examined as a witness in this case, and a sister of Mary Alice Stevenson, who has just testified.

Q. 1. Did you attend the Centennial Exposition at Philadelphia?

A. Yes, sir.

Q. 2. What house was your father living in when you went to the Centennial?

A. At the corner of Third and Chestnut streets—no, I made a mistake; it was Market street.

Q. 3. Do you remember the number on Market street.

A. No. 1020.

Q. 4. What house did your father live in last, before he moved into No. 1020 Market street?

A. At Third and Chestnut streets.

Q. 5. Do you know Daniel Drawbaugh, of Milltown, Cumberland county?

A. I do.

Q. 6. Were you ever at his shop in Milltown?

A. I was.

Q. 7. How happened you to go there the first time that you ever went there?

A. We went chestnutting and stopped there.

Q. 8. How did you get over there from Harrisburg on that trip?

A. We went as far as New Cumberland in the cars, and walked from there to the mill.

Q. 9. How did you get back from Drawbaugh's shop to your home that day?

A. We walked from the mill to Bridgeport, and rode over the bridge on an engine.

Q. 10. Where did you get off of the engine, when you got to Harrisburg?

A. At the corner of Third and Mulberry streets.

Q. 11. Do you remember why the engineer stopped his engine to let you off at that point?

A. Because it was the nearest to our home.

Q. 12. Where was your home at that time and how near was it to the corner of Third and Mulberry, streets where the engineer let you off?

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A. Our home was at Third and Chestnut, and it was just a square from Third and Mulberry.

Q. 13. How came you to ride across on the engine that day; did you ask the engineer to let you do it, or did he offer to take you across?

A. We were very tired when we arrived at Bridgeport, and my father asked him to take us over.

Q. 14. Was your father with you on that chestnutting trip?

A. Yes, sir.

Q. 15. While on that trip that day, did you take lunch anywhere; if so, where?

A. We took lunch by a small spring near Drawbaugh's mill.

Q. 16. Do you remember about what time of day you took lunch?

A. I don't remember.

Q. 17. Where did you spend the afternoon that day until you started home?

A. We were in Drawbaugh's shop till we started home.

Q. 18. Do you remember what time you started home?

A. I don't remember; but I suppose it was early in the afternoon because we had a good way to walk.

Q. 19. What were you doing in Drawbaugh's shop that afternoon?

A. We were looking at pictures, a couple of old clocks, and the telephone.

Q. 20. Did you do anything with the telephone; if so, what?

Objected to as leading and improper mode of inquiry.

A. We spoke through it.

Q. 21. In what part of the shop were you while the speaking through the telephone was going on?

A. I was in the basement.

Q. 22. Did you speak through the telephone, or listen at it, or both?

Same objection as to question 20.

A. I spoke and listened, both.

Q. 23. Who was speaking into the instrument at the other end of the line when you listened at the telephone?

Objected to as assuming and because no sufficient foundation has been laid for the question.

A. Mr. Drawbaugh.

Q. 24. Tell us whether or not, you heard and understood what was said through the telephone when you were listening at it?

Objected to as leading.

A. I heard and understood both, what was said.

Q. 25. When you heard what was said through it, you were in the basement, if I understand you?

Objected to as leading and assuming.

A. Yes, sir.

Q. 26. And were you in the basement when you talked into the machine?

A. Yes, sir.

Q. 27. Did yo' use the same instrument in the basement to talk into and listen at, or were there two instruments there?

A. I don't remember.

Q. 28. Were you ever in Drawbaugh's shop again after that visit, and before the suit about Drawbaugh's telephone began?

A. I don't know when the suit began; I was in the shop about three years ago.

Q. 29. Was that the first time you had been in the shop since your first visit there?

A. Yes, sir.

Cross-examination waived by Mr. Howson.

FLORENCE A. STEVENSON.

Affirmed and subscribed to before me this 5th day of March, 1885.

FRED. M. OTT,
Special Examiner.

George W. Hunter being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is fifty-six; residence, Harrisburg, Penna.; occupation, proprietor of the Lochiel hotel, Harrisburg; I have been there since the spring of 1868, when I bought it out.

Q. 1. Will you tell the court in what way you first learned of Daniel Drawbaugh's telephone, or talking-machine?

A. I learned of it through Dr. John W. Moffitt.

Q. 2. What conversation did you have with Dr. John W. Moffitt about it at the time?

Objected to as calling for hearsay.

A. The doctor brought it to my attention and told me it would be a good investment; and he wanted me to take stock in it—invest in it.

Q. 3. Why didn't you invest in it?

A. Well, for the reasen that I didn't know anything about it; and I never invest outside of my own business, or very seldom; in fact, I did not have the money to invest at that time.

Q. 4. State whether or not Dr. Moffitt asked you to go over to Drawbaugh's shop and see the machine?

Objected to as leading and incompetent.

A. He invited me over there more than once to look at it.

Q. 5. Was it before or after the Centennial Exposition at Philadelphia, that you first had these conversations with Dr. Moffitt?

Same objections as to last question, and further objected to as asking for guess-work.

A. My impression is, that it was before the Centennial.

Q. 6. At the time when Dr. Moffitt first spoke to you about this talking machine, had you ever heard of such a thing as a speaking telephone?

Same objection as to last question.

A. I don't think I did, till Dr. Moffitt mentioned it to me.

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Q. 7. Do you mean, till Dr. Moffitt mentioned this machine of Drawbaugh's to you?

Objected to as leading and improper.

Cross-examination waived by Mr. Howson.

G. W. HUNTER.

Sworn and subscribed to before me this 5th day of March, 1885.

FRED. M. OTT,
Special Examiner.

George W. Bowman being produced, affirmed and examined, saith:

Examined by Mr. Hill:

My age is forty-two; residence, Mechanicsburg, Cumberland county, Penna.; occupation, dentistry.

Q. 1. Do you know Daniel Drawbaugh, of Eberly's Mills, or Milltown?

A. Yes, sir.

Q. 2. Were you ever at his shop at Milltown?

A. Yes, sir.

Q. 3. Did you ever see any talking machine there?

Objected to as leading.

A. Yes, sir.

Q. 4. Do you remember the first occasion when you ever saw any talking machines in Mr. Drawbaugh's shop?

A. Yes, sir.

Q. 5. How happened you to be at Milltown on that occasion?

A. During the baptism of Mrs. William B. Gorgas; I remember that she was one of the candidates that were baptised; I went down to see the baptism.

Q. 6. Did you go from Mechanicsburg?

A. Yes.

Q. 7. How did you go?

A. Drove in a buggy.

Q. 8. Did you take anybody with you in the buggy on that trip?

A. Yes, sir.

Q. 9. Whom?

A. My wife and my little boy.

Q. 10. What is that little boy's name?

A. John; he is a pretty big boy now; at that time he was a little boy.

Q. 11. How old was he at that time?

A. To the best of my knowledge between two and three years.

Q. 12. Can you give me the date of his birth?

A. Well, this way you can get at it; we were married on the 10th of February; he will be eighteen years old on the 10th of November, 1885.

Q. 13. That would make the date of his birth November 10th, 1867?

A. Yes, sir.

Q. 14. At the time when you and your wife and child rode down to witness the baptism, where were you living?

A. At Mechanicsburg.

Q. 15. In whose house?

A. John C. Rupp's, my father-in-law.

Q. 16. Were you keeping house or living with the family?

A. Living with the family.

Q. 17. Who were the members of Mr. Rupp's family at that time?

A. He and his wife, and my wife, myself and child.

Q. 18. Is your mother-in-law, Mrs. John C. Rupp, still living?

A. No, sir.

Q. 19. When did she die?

A. About fourteen years ago, as near as I can tell.

Q. 20. How long were you in Mr. Drawbaugh's shop that day that you went to the baptism?

A. Well, to the best of my knowledge, I suppose, half an hour, or perhaps three-quarters of an hour.

Q. 21. Was your wife in the shop with you?

A. No, sir.

Q. 22. Where did she stay while you were in the shop?

A. She was in the buggy.

Q. 23. While you were in Drawbaugh's shop that day of the baptism, what, if anything, was done with the talking machine that you saw there?

A. It was used to talk through.

Q. 24. Who talked through it?

A. Mr. Daniel Drawbaugh.

Q. 25. And who listened?

A. I did.

Q. 26. In what part of the shop did Mr. Drawbaugh do the talking?

A. It was on the third floor, if my memory serves me right.

Q. 27. And where did you do the listening?

Answer objected to by Mr. Howson, in view of answer to 26.

A. Down in the basement.

Q. 28. Where did you first see the machine that day?

A. On the third floor.

Q. 29. Who directed you into the basement to listen?

A. Mr. Drawbaugh, and he went down with me to show me where the machine was, and how to put it to my ears.

Q. 30. While you were listening at the instrument in the basement, and Drawbaugh was talking into the instrument on the third floor, did you hear anything through the instrument?

Objected to as assuming what has not been shown.

A. Yes, sir.

Q. 31. What did you hear through it?

A. "Helloa!"—"Do you hear me?"—and other words that I could not give.

Q. 32. How was the instrument in the basement connected with the instrument on the third floor?

Objected to as assuming and because no sufficient foundation has been laid for it.

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A. With a wire, or wires; I couldn't tell whether there was one or more.

Q. 33. How did the wire or wires run, if you remember?

A. Up to the ceiling, to the best of my knowledge.

Q. 34. Did the wires appear to be hanging loose, or otherwise?

A. They appeared to be hanging loose; yes, sir.

Q. 35. Do you remember the shape or appearance of the instruments themselves?

A. No, sir; not particularly?

Q. 36. Do you think you could identify them if you saw them again?

A. No, sir.

Q. 37. Did you ever hear any talk through Mr. Drawbaugh's talking machine after that visit?

Objected to as leading.

A. Yes, sir.

Q. 38. Are you able to state how long after that first visit it was, that you next heard talk through the machine?

A. No, sir.

Q. 39. On the second occasion that you heard through the talking machine, who did the talking through the machine?

A. Mr. Drawbaugh.

Q. 40. Where was he then, and where were you?

A. He was up on the third floor, and I was down in the basement.

Last preceding answer objected to by Mr. Howson, in view of the present answer, as not evidence.

Q. 41. How do you know it was Mr. Drawbaugh who did the talking on that second occasion?

A. Well, he said he would talk through the machine to me?

Objection continued by Mr. Howson.

Q. 42. When you listened at the instrument in the basement, on the second occasion, did you hear anything through it or not?

Objected as leading.

A. Yes, sir.

Q. 43. What did you hear through it then?

A. "Helloa!" and "Do you year me?"—to the best of my knowledge, that is what he said.

Q. 44. Is that all that was said, or were there other things said through the machine that you do not remember sufficiently to repeat?

Objection continued.

A. There was some sound, but what it was I could not tell.

Q. 45. Do you mean that you could not tell at the time, or that you do not now remember?

Objection continued.

A. I do not now remember.

Q. 46. On either of those occasions, did you hear any other sounds through the machine besides talking?

A. Yes, sir.

Q. 47. What other sounds.

A. Well, I would merely call it sounds, not talking; that is what I had reference to when I mentioned that they were roaring sounds, as near as I can tell.

Cross-examined by Mr. Howson:

X-Q. 48. How long have you been living in Mechanicsburg?

A. Eighteen years or nineteen years, as near as I can tell?

X-Q. 49. In the late suit of the American Bell Telephone Company and others against the People's Telephone Company and others in the U. S. Circuit Court for the southern district of New York, one of the witnesses examined on the part of defendants, was one Henry N. Bowman (see page 1135, defendant's sur-rebutting testimony), that Mr. Bowman testified among other things, that he resided at Camp Hill, Cumberland county; is a justice of the peace, and that at or shortly after the commencement of that suit, he visited a number of persons in Cumberland county, in company with one of defendant's counsel, and took a number of affidavits for defendants in said case; if

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that Henry N. Bowman is a relative of yours, say what the relationship is?

Objected to as immaterial and irrelevant.

A. A brother.

X-Q. 50. In the same case a certain Zacheus Bowman testified on behalf of defendants (see page 639, volume 1, defendant's printed proofs), giving his age as forty-six, his residence Camp Hill, Cumberland county, and his occupation farmer; if that Mr. Bowman is a relative of yours, what is the relationship?

Same objection.

A. A brother.

GEORGE W. BOWMAN.

Sworn and subscribed to before me this fifth day of March, 1885.

FRED M. OTT,
Special Examiner.

Mrs. Maggie E. Bowman being produced, affirmed and examined, saith:

Examined by Mr. Hill:

I am the wife of George W. Bowman, of Mechanicsburg, who has just testified.

Q. 1. Did you ever, in company with your husband and one of your children, attend a baptism at Eberly's Mills?

A. Yes, sir.

Q. 2. Which one of your children was it that went with you?

A. Our oldest one, John.

Q. 3. What is your recollection as to about what his age was at the time of that baptising?

A. He was about two years and a half old, I think.

Q. 4. In what house were you living at the time when you went to that baptising?

A. My father's, in Mechanicsburg.

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X-Q. 5. What sort of a clock was that which was on the third story, as you have stated?

A. Well, it was the same as the clocks that are used now as near as I can tell.

GEO. W. BOWMAN.

Affirmed and subscribed to before me this fifth day of March, 1885.

FRED. M. OTT,
Special Examiner.

Edward W. Eby being produced, sworn and examined, saith:

Examined by Mr. Hill:

I am almost forty-four years of age; residence, Newville, Cumberland county, Penna.; occupation, painter.

Q. 1. Will you tell us how you first heard of Mr. Daniel Drawbaugh's talking machine?

Objected to as assuming and leading.

A. I heard it through Harman K. Drawbaugh; he told me.

Answer objected to by Mr. Howson as hearsay.

Q. 2. What did he tell you about it?

Objected to as calling for hearsay.

A. He told me that it was fixed up with wires, and that you could talk in at one end, and that you could be heard a mile away.

Q. 3. Who did you next hear speak of Mr. Drawbaugh's talking machine?

Objected to as calling for hearsay and as leading.

A. Major Henry Snyder was the next that I heard speak of it.

Q. 4. Tell us the circumstances under which Major Snyder spoke of it to you?

A. I was sitting on the platform in front of his office at Newville, and Mr. Drawbaugh was going towards the

ticket office; Major Snyder asked me if I knew that man; I told him I did, that it was Daniel Drawbaugh; Major Snyder then told me that he was up to get him to go into partnership, or buy the one-fourth, or something of that kind, I don't know which, of a talking machine that he was going to get patented—something of that kind; he said, then, something about five thousand dollars; that he wasn't going to put that much into anything of that kind; that he thought Dan Drawbaugh was a little off; that is about all that I know about it.

Q. 5. At how early a time was this conversation between you and Major Snyder?

A. It was before the 19th of June, [illegible] 3.

Q. 6. How do you know that it was before that date?

A. Because we fell out over a settlement a little bit before that date; it might have been a week or so before, and we were not on speaking terms after that, unless when something had to be done.

Q. 7. When that settlement was made, was it in writing?

A. Yes, sir.

Q. 8. Have you the writing here?

A. Yes, sir.

Q. 9. In whose handwriting is this paper?

A. It is in the handwriting of Simon Snyder, a brother of Major Snyder.

(Witness produces paper dated June 19th, 1873.)

Objected to by Mr. Howson as not proven.

Q. 10. Do you know how long before this settlement, this conversation was had with Major Snyder about the talking machine?

A. No, sir; I do not.

Q. 11. Do you know how long the conversation with Harman K. Drawbaugh was before the conversation with Major Snyder?

A. No, sir; I do not; the only thing I know is that it was before Major Snyder talked to me.

Q. 12. When Major Snyder talked to you, did it recall the prior conversation?

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Objected to as leading, and putting statements into the mouth of the witness.

A. Yes, sir; it did.

Deposition objected to as hearsay of hearsay.

Cross-examination de bene esse by Mr. Howson:

X-Q. 13. How long have you been living at Newville?

A. I would suppose about thirty-eight or thirty-nine years, from what I have been told.

E. W. Eby.

Sworn and subscribed to before me this fifth day of March, 1885.

Fred. M. Ott,
Special Examiner.

Adjourned until March 6th, 1885, at 10 A. M.

March 6th, 1885, 7:30 P. M.

Examination resumed, no session having been held earlier in the day on account of absence of witnesses.

Joseph H. Gregory being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is thirty-three; residence, Raynham, Mass.; I am a dairy farmer.

Q. 1. How far is Raynham from Boston?

A. Thirty miles.

Q. 2. What is your father's name?

A. Emanuel K. Gregory.

Q. 3. Did you formerly live in Duncannon, Perry county, Pennsylvania?

A. I did.

Q. 4. When did you move away from Duncannon, Penna?

A. Some time in March, 1870.

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Q. 5. When you moved from Duncannon, Penna., where did you move to?

A. To Eberly's Mills, Cumberland county.

Q. 6. How long did you live at Eberly's Mills, Cumberland county?

A. From March until the next December—about the 10th or 11th of December.

Q. 7. When you moved away from Eberly's Mills, or Milltown, about the 10th or 11th of December, 1870, where did you move to?

A. Raynham, Mass.

Q. 8. Have you lived in Raynham, Mass., ever since that time?

A. I have.

Q. 9. You state that you moved away from Pennsylvania about the 10th or 11th of December, 1870; when were you next inside of the State of Pennsylvania after that day?

A. March the 6th, 1885,—today.

Q. 10. Then you have never been in this State until today, since you moved away in 1870?

A. I have not.

Q. 11. How old were you when you moved away from Pennsylvania, in December, 1870?

A. Eighteen years, eleven months and ten days.

Q. 12. While you lived at Eberly's Mills in 1870, whose family did you live in?

A. My father's.

Q. 13. Did your father and his family move from Duncannon to Eberly's Mills when you did?

A. They did.

Q. 14. Where does your father now live?

A. East Taunton, Mass.

Q. 15. In what year did your father move to East Taunton, Mass.

A. In 1870.

Q. 16. Did he move there when you did, or before, or after.

A. Before.

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Q. 17. How far is your residence from East Taunton?

A. Two miles and a half.

Q. 18. While you and your father were living at Eberly's Mills, what business was he engaged in?

A. Machinist.

Q. 19. Where did he work?

A. At the Drawbaugh Manufacturing Company.

Q. 20. Did you do any work for that company?

A. I did.

Q. 21. Do you know whether the account of your father with that company was finally settled, before, or after your father left Milltown?

A. After father left Milltown.

Q. 22. Who settled that account with your company?

A. Myself.

Q. 23. Did you settle it before or after you left Milltown?

A. Before.

Q. 24. How long before?

A. About a week.

Q. 25. What member of the company settled that account and paid it off?

A. The secretary and treasurer, Dr. Mosser.

Q. 26. When did you first know of Daniel Drawbaugh's talking machine?

Objected to as leading and assuming.

A. Some time during the time I worked there at Milltown, in 1870.

Q. 27. Have you any recollection whether you ever talked through the machine, or not, there?

Same objection.

A. I haven't any.

Q. 28. What is your recollection as to where the machine was at that time, in 1870?

A. Up stairs in the office.

Q. 29. Is there any circumstance in your memory, connected with that talking machine, that you distinctly remember?

A. There is one.

Q. 30. Please state it?

A. Mr. Drawbaugh, taking his little stick and dipping it into a little box that he had below, that had some stuff in it, and putting it on a wart that I had on the back of my hand—a large wart.

Q. 31. Do you remember what kind of stuff was in the little box that he dipped the stick into and put it on your wart?

A. I asked him what kind of stuff it was, and he told me it was some kind of acid.

Answer objected to by Mr. Howson as not evidence.

Q. 32. When did he tell you that?

A. When he put it on my hand.

Q. 33. You have mentioned that box of acid as having some connection with the talking machine, in your memory; what was your understanding at the time, as to whether it was or was not connected with the talking machine?

Objected to as leading.

A. It was; I understood it was; there were wires running to it.

Q. 34. Do you remember the appearance of the talking machine?

A. I don't seem to.

Q. 35. Who first spoke to you, within the last four or five years, about Drawbaugh's talking machine and your recollection of it?

A. A man by the name of Tompkins.

Q. 36. Where did he speak to you about it?

A. At my residence.

Q. 37. Did he come there to see you about it?

A. He did.

Q. 38. About how long ago was that?

A. I should think it was three years ago this last summer.

Q. 39. What did you tell him when he asked you about Drawbaugh's talking machine?

This line of examination objected to as incompetent.

A. I told him I knowed he had something of the kind that he used to talk into.

Q. 40. Did Mr. Tompkins speak of going to see anybody else in your vicinity, with reference to that talking machine?

Same objection, and as immaterial.

A. He did; he either said he was going to see my father, or had seen him?

Q. 41. You say that Mr. Drawbaugh used to talk into the machine; did you tell Mr. Tompkins where the talking was done, or from what place to what place?

Objected to because the witness has not testified as the question asserts, and because the question is leading, and especially incompetent in view of interrogatories 27 to 30, and the answers thereto, and because what the witness may have heretofore stated in conversation is not evidence for any purpose in this cause.

A. I did not; I told him it was used in the shop; I want it just as I said it; those are the words I used to him—that it was used in the shop.

Q. 42. Have you ever been to Milltown since you moved away from there in December, 1870?

A. I have not.

Cross-examined by Mr. Howson:

X-Q. 43. When did you leave home to come here to testify?

A. Yesterday afternoon.

X-Q. 44. Who, if any one, traveled here with you from your home, or any part of the journey?

A. My father.

X-Q. 45. When and by whom were you asked to come here to testify?

A. Yesterday morning, by Mr. Fenn.

X-Q. 46. At the time you lived at Eberly's Mills, and did

work for the faucet company there, you were eighteen years old, is my understanding correct?

A. It is.

X-Q. 47. About how long did you work for the faucet company there?

A. From some time in the last of April till the middle of December.

JOSEPH H. GREGORY.

Sworn and subscribed to before me this sixth day of March, 1885.

FRED. M. OTT,
Special Examiner.

March 7th, 1885, 10 A. M.

Examination resumed.

Present: same counsel.

Emanuel R. Gregory being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is almost sixty-two; residence, East Taunton, Mass.; occupation, machinist.

Q. 1. Did you formerly reside at Duncannon, Perry co., Penna.?

A. Yes, sir.

Q. 2. Where did you move to from Duncannon?

A. Milltown, Cumberland county, Penna.

Q. 3. At what time did you move from Duncannon to Milltown?

A. March, 1870.

Q. 4. How long did you live at Milltown?

A. From March—my family staid in Milltown till December, but I left before that.

Q. 5. At what time did you leave?

A. October, 1870.

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Q. 6. When you left Milltown in October, 1870, where did you go to reside?

A. East Taunton, Mass.

Q. 7. Have you resided in East Taunton ever since that time?

A. No, sir; when I moved I went to live in Raynham, Mass.

Q. 8. Do you mean when you moved your family there?

A. Yes, sir.

Q. 9. After you left Milltown in October, 1870, when did you return to Pennsylvania again for the first time?

A. On March the 6th, 1885—yesterday.

Q. 10. Have you ever been at Milltown since you left there in October, 1870?

A. No, sir.

Q. 11. While you were living at Milltown in 1870, what was your employment?

A. Machinist's business.

Q. 12. For whom did you work at Milltown?

A. The Drawbaugh Manufacturing Company.

Q. 13. In the minute-book of the Drawbaugh Manufacturing Company, I find the record of a meeting of said company held on March 18th, 1870, which record is as follows:

"Meeting of the Drawbaugh Mfg. Co., Mar. 18, 1870, at the house of Wm. R. Gorgas. Members present: Gorgas, Rupp, Hertzler, Sheely, and Mosser, with Jno. Kutz as representing new organization. Absentees: Jno. F. Hursh, Jos. C. Hursh, D. Drawbaugh, A. H. Gardner, W. L. Gorgas, and Geo. Wise. William R. Gorgas was chosen Pres. *pro tem.* Business of the company was the previous question of new and full organization, & the consideration of the *articles of association*, & minutes of last meeting deliberated upon. As to the former, it was postponed for signatures, with instructions to see the Sect. to inquire more fully into its legality. The latter—basis of valuation of $10,000, exclusive of faucets, book account, loose iron, &c., in & around the said manufactory, was misunderstood as

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claimed by the new members. They claimed faucets, &c., said book account to be included in said valuation, and in consequence the company suggested & conceded various terms, viz., M. B. Mosser suggested that on the original or valuation of Feb. 7th, 1870, the company throw in the patterns & new work in prospect of the new company, & they, the old company, would pay expenses of the same as contribution for the aforesaid misunderstanding. This was rejected by Mr. Kutz, with the reply that that would not do, & desired something different. Again, M. S. Rupp suggested the terms of contribution to be 12½ per cent. off on the shares—viz., 2, two, S—par value $100 each to Mr. Gregory, & Mr. Kutz the same discount on his prospective interest, viz., seven (7) shares at $537½. This was finally agreed upon by Mr. Kutz as representative of Kutz & Gregory. It was conceded by the company that if Kutz & Gregory occupy one house, that said Co. pay the $25 rent, as agreed by Kutz on the original proposition, after which the Co. adjourned.

"M. B. Mosser,
"Sect. & Treas."

Are you the Mr. Gregory who is referred to in this record?

A. I believe so.

Q. 14. In the first ledger of the Drawbaugh Manufacturing Company I find the following entry on page 57; to wit:

"Emanuel Gregory (Duncannon).

1870.		1870.		
Jan. 10.	To mdse. 109,	$27.00	Mar. 15. By cash, 112,	$15.00
			June 3. " F. returned, 117,	12.00
		$27.00		$27.00"

And in the corresponding day book of said company I find the following entries, to wit:

On page 109, under date of January 10, 1870:

"Emanuel Gregory. Dr.

To one dozen Faucets, - - - - - - $27.00"

On page 112, under date of March 15, 1870:

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"Received of E. Gregory:

Cash on account, - - - - - - - - $15.00"

On page 117, under date of June 3, 1870:

"Emanuel Gregory.

By 4 Faucets returned, - - - - - - $12.00"

Are you the Emanuel Gregory, of Duncannon, there referred to?

A. Yes, sir.

Q. 15. In the second ledger of the Drawbaugh Manufacturing Company, on page 28, I find the following entry, to wit:

"28. Emanuel Gregory (Eberly's Mills.)

1870.				1870.			
June 16,	To Cash, &c.,	3	$13.86	July 30,	By labor,	7	$169.20
" 27,	" Cash	"	25.00	" "	" Cash,	"	8.86
July 30,	" Cash, &c.	7	139.20				
			178.06				178.06
Nov. 2,	To Faucets,	11	23.00	Dec. 6,	By labor,	14,	277.52
" 2,	" Cash,	11	50.00	" "	" Cash	14,	28.00
" 16,	" Flour,	12	7.00	" "	" Cash	"	28.00
Dec. 6,	" Cash,	14	153.41	" "	" Cash		41.00
" 6,	" or Good	"	58.01				
" "	" " Horst	"	9.10				
" "	" Rent, &c.	"	41.00				
			$346.52				$346.52

and in the corresponding day book of said company I find the following entries, to wit: on page 3, under date of June, 16, 1870:

"E. Gregory,

To Cash, - - - - - 5.00
" ½ Boat Lumber, - - - - 2.60
" Paint and Oil, - - - .30
" 1½ doz. screws, - - - - .06
" Coal last April, - - - 5.90

13.86."

On the same page under date of June 27, 1870:

"E. Gregory,

To Cash, - - - - - 25.00"

On page 7 under date of July 30, 1870, the following:

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" Emanuel Gregory,

By labor in shop, - - - $169.20
To Cash, - - - - - - - - - 123.85
" S. M. Hertzler's order, - - - - - 8.00
" Board with Hertzler, - - - - - 7.35
Received from E. Gregory, cash - 8.86"

On page 11, under date of Nov. 2, 1870, the following:

" Emanuel Gregory,

To 2 Faucets
" 1 doz. " at $24 - - - $28.00"

On the same page under date of Oct. 28th, 1870, the following:

" Paid E. Gregory on ac. for labor, 50.00"

On page 12, under date of Nov. 16, 1870, the following:

" Emanuel Gregory,

To 1 Barrel of Flour, - - - $7.00"

On page 14, under date of Dec. 6th, 1870, the following:

" E. Gregory & Son,
By labor in shop, self, - - - $125.72
" do. do. Son, - - 151.80 277.52
To Cash, . - - 153.41
To Order on D. H. Good, 58.01
" do. M. Horst, 9.10
E. Gregory,
To House Rent and Lumber, - - 41.00
By Cash for Faucets, - - - 28.00
" Cash House Rent, - - - 41.00"

Are you the Emanuel Gregory referred to in these last mentioned ledger and day-book accounts:

A. Yes, sir.

Q. 16. From the day book entry of December 6, 1870, on page 14, I find your son credited with labor in the shop; did your son work with you in the shop?

A. Yes, sir.

Q. 17. Which of your sons was that?

A. Joseph H. Gregory.

Q. 18. The last entries, both in the day book and ledger, are under date of December 6, 1870, which was after the

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time when you say you left for Massachusetts; and they seem to be in the nature of a final settlement between you and the company; did you make that settlement, or did somebody make it for you; and if the latter, who?

A. My son, Joseph H. Gregory, made it for me.

Q. 19. When you lived at Milltown and worked for the Drawbaugh Manufacturing Company, was Daniel Drawbaugh employed by said company?

A. Yes, sir.

Q. 20. What position did you hold in the shop?

A. Foreman.

Q. 21. When and where did you first know anything about Mr. Daniel Drawbaugh having a talking machine?

Objected to as assuming and leading.

A. At Milltown, in 1870.

Q. 22. State whether or not you ever saw his talking machine?

Objected to as leading.

A. I did.

Q. 23. State whether or not you ever talked through it, or heard anybody talk through it?

Objected to as leading.

A. I heard Daniel Drawbaugh.

Q. 24. In what year did you first see Mr. Daniel Drawbaugh's talking machine and hear Mr. Drawbaugh talk through it?

A. In 1870.

Q. 25. How many times did you hear Mr. Drawbaugh talk through it in 1870?

A. Quite a number of times.

Q. 26. When Mr. Drawbaugh talked through the machine and you listened at it, in 1870, where did Mr. Drawbaugh do the talking?

Objected to as assuming.

A. Up stairs in his office.

Q. 27. On what floor was that?

A. The machine shop floor.

Q. 28. There are two floors in the building; was it on the lower floor, or upper floor?

A. Both of them.

Q. 29. And where did you do the listening, when you listened at the machine?

A. Both in the machine shop and in the basement.

Q. 30. When Drawbaugh talked into the machine and you listened at it, state whether or not you heard and understood anything that he said through it?

Objected to as leading.

A. I did, distinctly.

Q. 31. When that talking and listening through the machine was going on, do you remember any subject of conversation that was talked about through the machine, or not?

Objected to as assuming.

A. I did.

Q. 32. What subject do you remember being talked about through the machine at that time?

A. The subject of manufacturing the faucets.

Q. 33. Please state what you remember about Mr. Drawbaugh's talking to you through the talking machine on the subject of manufacturing faucets?

A. He was talking on an improvement that he was making in the faucets.

Q. 34. When Drawbaugh talked to you through the talking machine, did you, or did you not, inform him whether you heard him plainly or not?

Objected to as leading.

A. I did.

Q. 35. In what way did you inform him?

A. By going to the door and hollering to him

Q. 36. You have stated that sometimes you listened on the machine shop floor, and sometimes in the basement; when you listened in the basement, where was Drawbaugh doing the talking?

A. Up stairs in his office.

Q. 37. Was his office on the first floor, or the second floor of the building?

A. The second floor.

Q. 38. Did you know at the time whether the instrument that you listened at was connected in any way with the instrument that he talked into; and if so, how they were connected?

A. By wires.

Q. 39. Do you remember how the wires ran from one instrument to the other?

A. There was a spring or coil of wire upon the end of the instrument that it was connected with. The wires run down from the instrument that he was talking with to the instrument I was listening at.

Q. 40. Were those wires hanging loose or drawn tight?

A. Loose.

Q. 41. When you listened at the instrument, was the instrument held in your hand, or lying on a table, or something?

Objected to as leading.

A. It was hanging down; so that I lifted it in my hand and put it to my ear.

Q. 42. Do you know whether that apparatus operated by electricity or not?

Objection continued.

A. By electricity.

Q. 43. Were there any batteries connected with it, or not?

Same objection.

A. I should say there was, from what I can recollect.

Q. 44. Did Mr. Drawbaugh, in 1870, make any statement to you as to how far the instrument would operate?

Objected to as calling for hearsay.

A. He did.

Q. 45. What did he say on that subject?

Same objection.

A. He said he could talk from Milltown to Harrisburg in one minute; and he said: "I don't know whether it won't supersede the telegraph wire yet."

Q. 46. Please look at the instruments "B", "F", "C", "C reproduced", and "I", and state whether you recognize any of them or not?

Objected to as a leading and improper mode of inquiry.

A. I do.

Q. 47. Will you point out to the examiner which of them you recognize?

A. I will. (Witness points out "B" and "F".)

Q. 48. In what year did you first see these two instruments, "B" and "F"?

A. In 1870.

Q. 49. When did you next see them again after 1870?

A. In 1885, on yesterday, Friday, the 6th of March.

Q. 50. Are these the instruments that the talking was done through in 1870 in Mr. Drawbaugh's shop?

Objected to as leading.

A. Yes, sir.

Q. 51. Which of them did you use to listen at?

A. This one (indicating "B.")

Q. 52. When you listened at this instrument, in 1870, do you remember whether the end of the box next to the electro-magnet was open, as it is now, or whether it was covered with something?

Objected to as a leading and improper mode of inquiry.

A. If I recollect right, it was covered.

Q. 53. You have testified to using the machines a number of times at Mr. Drawbaugh's shop, and that you heard and understood distinctly what was said through them; did you so hear and understand on one occasion, or on different occasions?

Objection continued.

A. Different occasions.

Q. 54. Do you remember how long you and Mr. Drawbaugh would operate the machines on the different occasions?

A. Well, I should say from ten to fifteen minutes sometimes; sometimes not so long.

Q. 55. Who first spoke to you, within the last four or five years, as to your knowledge or memory of Drawbaugh's talking machines?

A. I think his name was Hollis, if I understood it right.

Q. 56. How long ago did this person speak to you about it?

A. I think it is somewhere about three years ago.

Q. 57. Did he come to see you about it?

A. Yes, sir.

Q. 58. Did he mention anything about seeing any of the rest of your family about it?

Objected to as incompetent and immaterial.

A. He did.

Q. 59. What did he say about seeing any of the rest of your family?

An objection is here entered to this line of examination, inasmuch as statements which this witness may have made, or may say that he made, about or in any way relating to the subject as to which he has been testifying, at some time preceding his examination, cannot be evidence for defendants in this case for any purpose; this objection to apply to all succeeding inquiries as to the alleged conversation between this witness and one Hollis.

A. He said he had seen my son Joseph, and was going to see him again.

Q. 60. Your son Joseph testified here yesterday that a man named Tompkins came to see him about Drawbaugh's talking machine some three years ago or more, and mentioned to him that he either had been or was going to see you; have you any recollection of such a man being to see you?

Objected to as incompetent, the witness having already given his recollection.

A. Yes, sir.

Q. 61. Is that the man that you referred to above, or another man?

Objection continued.

A. That is the man.

Q. 62. What kind of a looking man was this Tompkins?

A. A kind of sandy complexion man with a sandy mustache.

Q. 63. Did you tell him anything about Drawbaugh's talking machine?

A. I did.

Q. 64. What did you tell him?

A. I told him that I had both seen it and heard Drawbaugh talk through it.

Q. 65. After you told him that, what did he say?

Objected to as immaterial and irrelevant.

A. He said that he was a friend of his.

Q. 66. He didn't tell you that he was an emissary of the Bell Telephone Company, did he?

A. He did not.

Recess until 2 P. M.

Counsel for respondents here states that the minute books and the account books of the Drawbaugh Manufacturing Company referred to in this deposition are the same that were referred to and used during the taking of defendants' proofs in the case of the American Bell Telephone Company et al. vs. The People's Telephone Company et al., in the U. S. Circuit Court for the Southern District of New York.

Cross-examined by Mr. Howson:

X-Q. 67. How long were you living in Duncannon, and in what employment were you during the time you were living there?

A. I believe I was there only about two years—somewhere about there, I think; machinist business.

X-Q. 68. Carrying on business there for yourself?

A. No, sir: employed by the Duncannon Iron Company.

X-Q. 69. Were you working for the Drawbaugh Faucet

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Company up to the time that you left Milltown, or did you leave their employ before leaving the village?

A. I worked up to the time of leaving the village.

X-Q. 70. What house did you occupy while living in Milltown, and who owned it?

A. I believe the company owned it—a stone house it was; in fact, I paid the rent to them.

X-Q. 71. How far from the shop was this stone house?

A. That is more than I can tell, how far; but it was about four or five minutes walk.

X-Q. 72. Did you occupy the whole house, or were there other tenants living there; if the latter, who were they?

A. Other tenants; there was a tenant in the building that adjoined it at one end, but was not a part of the tenement; and a man by the name of John W. Kutts lived in with me.

X-Q. 73. Was this John Kutts working for the faucet company while you were there?

A. Yes, sir.

X-Q. 74. Who, if you recollect, was it, who occupied the part adjoining the tenement?

A. I don't know; I forget his name, but his occupation was butchering.

X-Q. 75. Are we to understand that when you moved from Milltown, you went to East Taunton, Mass., or to Raynham, Mass., first?

A. To East Taunton, Mass.

X-Q. 76. How far apart are those two places?

A. They join together.

X-Q. 77. In what establishment are you engaged at the present time?

A. The Old Colony Iron Company.

X-Q. 78. You have stated that you listened at what you call a talking machine, sometimes in the basement and sometimes on the machine shop floor of the faucet factory; in which of these two places of the shop did you most frequently do the listening?

A. The machine shop.

X-Q. 79. What was the machine shop being used for at that time?

A. Manufacturing faucets, and general job work.

X-Q. 80. All or most of the work done in the place was going on on that machine shop floor; was it?

A. Yes, sir.

X-Q. 81. What position did the Mr. Kutts you have referred to occupy in the place?

A. Salesman for the faucets.

X-Q. 82. I notice in the minute book to which reference has been made in your direct examination, that at a meeting held on the 25th of March, 1870, it is stated among other things that Mr. John Kutts was elected superintendent; is that the Mr. Kutts that you refer to?

A. The same.

X-Q. 83. Was the room to which you have referred as Mr. Drawbaugh's office, on the same floor as the machine shop, or on another floor?

A. On the upper floor—his office.

X-Q. 84. Was your son Joseph living in the same house with you while you were residing at Milltown?

A. He was.

X-Q. 85. If I understand your testimony, you have been living at either East Taunton, Mass., or at Raynham ever since you moved away from Milltown, is that correct?

A. I have.

Re-direct by Mr. Hill:

Q. 86. While you were listening at the talking machine at the several times you have mentioned, who, if anybody, was in the shop besides yourself and Mr. Drawbaugh?

Objected to as not re-direct examination.

A. I don't really recollect anybody, the time that we was talking on it.

Q. 87. While you and Mr. Drawbaugh were talking on the talking machine, was the usual work going on in the shop or not?

Same objection.

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A. It was not.

Q. 88. Why not?

Objection continued.

A. It was in our own time, after working hours.

EMANUEL GREGORY.

Sworn and subscribed to before me this 7th day of March, 1885.

FRED. M. OTT,
Special Examiner.

Adjourned until Monday, March 9th, 1885, at 11 A. M.

March 9th, 1885.

Owing to absence of witnesses no session held during the morning or afternoon.

March 9th, 1885, 7:30 P. M.

Examination resumed.

Present: Same counsel.

Alexander A. Thomson being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is fifty-four; residence, Carlisle, Cumberland county, Penna.; no particular occupation just now; have recently been engaged in the cattle business in the West.

Q. 1. How long have you resided in Cumberland county?

A. Twenty-one years.

Q. 2. Were you formerly treasurer of Cumberland county?

A. I was.

Q. 3. In what years?

A. 1876, 1877 and 1878.

Q. 4. From January, 1876, to January, 1879, I suppose?

A. Yes, sir.

Q. 5. Since you were treasurer of said county have you held any other office; and if so, what office, and when?

A. I have held the office of sheriff of Cumberland county since then—from January, 1880, to January, 1883.

Q. 6. Who makes up the vouchers on which the county treasurers pay out the county moneys for county disbursements and expenses?

A. The county commissioners.

Q. 7. Who was your immediate predecessor in the office of county treasurer of Cumberland county?

A. Levan H. Orris.

Q. 8. Do you know Mr. Orris, well?

A. I do.

Q. 9. Do you know what his general reputation and standing in the community are as a business man and a man of truth?

A. Why, considered good.

Q. 10. You heard something of the alleged defalcation in the county treasurer's office during his term, I suppose; did you?

A. I did.

Q. 11. How soon after he went out of office did he settle up his accounts and square up with the county?

Objected to as not calling for the best evidence.

A. As soon as the auditors had finished auditing his account.

Q. 12. Is it one of the duties of the auditors to audit the accounts of outgoing treasurers?

A. It is.

Q. 13. And when they present their report after such auditing, is that the basis upon which the treasurers settle up with the county?

Same objection as to question 11.

A. It is the basis on which they make their final payment; they generally pay about what is due the county, and then wait until the auditors have audited their account, to find the exact amount due, for fear of mistakes.

Q. 14. From the general reputation and standing of Mr. Orris in the community in which he lives, would you or

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would you not, believe any statements that he might make on oath as a witness?

A. I would.

Q. 15. What effect, if any, do you think the stories circulated about the alleged defalcation have had upon his standing in the community?

Objected to as incompetent.

A. I can scarcely answer for the community; as far as I myself am concerned, it wouldn't have any bad effect; I don't know of any bad effect it has on him, or injury it has done him.

Cross-examination waived by Mr. Howson.

ALEXANDER A. THOMSON.

Sworn and subscribed to before me this 9th day of March, 1885.

FRED. M. OTT,
Special Examiner.

James J. Johnson being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is thirty-one; residence, Philadelphia, Pennsylvania; occupation, express agent.

Q. 1. How long have you resided in Philadelphia?

A. It will be a year on April 1st, 1885.

Q. 2. Before you resided in Philadelphia, where did you reside?

A. Harrisburg, Penna.

Q. 3. Were you related to Mr. William J. Stees, who was killed by a locomotive in the streets of Harrisburg in the year 1881?

A. Yes, sir; I was a nephew.

Q. 4. Were you ever employed in his office or in his business?

A. Yes, sir.

Q. 5. When?

A. A couple of times; I don't know exactly the—I was employed in 1878 and in 1880; I may have done some odd work besides that, such as collecting bills.

Q. 6. How long were you employed by him in 1878?

A. In the neighborhood of three months.

Q. 7. Do you remember about what time you went into his employ that year?

A. The latter part of February or early part of March.

Q. 8. And remained in his employment till what month?

A. Some time in May, 1878.

Q. 9. Where was his son Harry while you were in Mr. Stees' employ in 1878?

A. He was in Iowa part of the time, and through the West.

Q. 10. How happened you to be employed by Mr. Stees at that time?

A. I can't hardly say, except that knowing him and being related he gave me the position.

Q. 11. Who had filled that position before you took it?

A. His son, Harry.

Q. 12. When you gave up the position who took it?

A. His son, Harry.

Q. 13. What position did you have in Mr. Stees' business at that time?

A. I kept the books, with his assistance.

Q. 14. In Mr. Stees' office?

A. Yes, sir.

Q. 15. Where was his office?

A. Near Second street and the Pennsylvania Railroad; there is a little alley runs in there; I don't know what it is called.

Q. 16. While you were in Mr. Stees' office at that time, did he have a telephone line or lines running from his office to any point or points around the city of Harrisburg?

A. Yes, sir.

Q. 17. To what places did those telephone lines run from his office?

A. Harrisburg Car Company, to the Harrisburg Car Company's foundry and machine shop, and to Mr. Hildrup's house; I think to Mr. Boyer's house, too; but I am not sure.

Q. 18. Did you have occasion to use these telephone lines in the business of the office while you were there in 1878?

A. Yes, sir.

Q. 19. Do you remember the shape and appearance of the telephone instruments that were used on those lines for business purposes, while you were there that spring?

A. Yes, sir; the one we had in the office was the shape of an egg, except that it was flat. We used it to speak in and to hear, both.

Q. 20. Please look at complainants' exhibit, "Phelps' Snuff Box Telephone", used in the suit of the American Bell Telephone Company vs. The People's Telephone Company in the United States Circuit Court, for the Southern District of New York, and state how that compares with the oval instrument you have just referred to as used at Mr. Stees' office, in the spring of 1878?

A. It was a style very similar—the exact shape as near as I can remember.

Q. 21. Please look at complainants' exhibit, "Phelps' Crown Telephone", used in the last mentioned suit, and state whether or not you ever saw such an instrument as that at Mr. Stees' office, while you worked there in the spring of 1878?

A. No, sir; not in the spring of 1878.

Q. 22. Did you ever see any of Daniel Drawbaugh's speaking telephones?

A. Yes, sir.

Q. 23. When and where did you first see any speaking telephone of Mr. Drawbaugh's?

A. In the spring of 1878, in the office of Mr. Stees, where I was employed.

Q. 24. Who brought Mr. Drawbaugh's telephone there?

A. Mr. Drawbaugh.

Q. 25. Do you remember whether that was before or after Harry Stees' return from the West?

A. After.

Q. 26. Do you remember how long after?

A. Not exactly—inside of a few days or a couple of weeks.

Q. 27. After you finished that employment with Mr. Stees, that spring, what did you do that summer?

A. Worked for the Union Transfer Company at Philadelphia.

Q. 28. What time did you go to work for the Union Transfer Company?

A. Some time in June, I think, of 1878.

Q. 29. How long did Mr. Drawbaugh's telephone remain at Mr. Stees' office that spring?

A. I couldn't say, but think it was there when I left, yet.

Q. 30. Was anything done with it while it was there at Mr. Stees' office that spring?

A. Yes, sir.

Q. 31. What was done with it?

A. We experimented with it the day Mr. Drawbaugh brought it there. We put it on Mr. Stees' telephone line.

Q. 32. Who connected it to the telephone line?

A. Mr. Drawbaugh.

Q. 33. Did he take off the Phelp's snuff box instrument, or attach his own instrument to the line, leaving the snuff box instrument on?

A. Attached his own instrument to the line, leaving the snuff box instrument also on?

Q. 34. What experiments did you make that day with Mr. Drawbaugh's telephone?

A. Harry Stees talked through Mr. Drawbaugh's instrument to the other end of the line; and I used the snuff box to hear and get the answer from the operator at the other end of the line.

Q. 35. How satisfactorily did Mr. Drawbaugh's instrument seem to work?

A. I thought it was very satisfactory at that time.

Q. 36. How did its working compare with that of the snuff box instrument before that time?

A. It seemed to give more satisfaction as to the distance of talking through it. The operator at the other end of the line seemed to hear very plainly, or said he did.

Answer objected to by Mr. Howson as not evidence.

Q. 37. At what distance or distances did Mr. Harry Stees stand from the Drawbaugh transmitter while talking into it, as far as you remember?

Objected to because no foundation has yet been laid for the question.

A. At several distances; it may have been one foot, or it may have been three—somewhere around there.

Q. 38. Tried it at different distances, did he?

A. Yes, sir.

Q. 39. In using the snuff box instrument as a transmitter, in Mr. Stees' business, how near were you accustomed to place your mouth to the mouth piece of the snuff box?

A. Pretty close; we sometimes had to vary it.

Q. 40. Closer than Harry Stees stood to the Drawbaugh instrument, or farther?

Objected to as a leading and improper mode of inquiry, and as calling for mere guess work.

A. Closer.

Q. 41. How certain are you that it was this snuff box form of instrument which you used as a receiver that day, while Harry Stees was talking into the Drawbaugh transmitter?

Objected to as leading, and because the witness has already given the best of his recollection as to the form of instrument referred to.

A. I am as certain as my memory will serve me.

Q. 42. In using Mr. Stees' telephone line with the snuff box instruments, in and about his business, were you accustomed to have a battery in line?

Objected to as leading, because it has not yet been

made to appear that the witness is competent to speak on that subject.

A. There was a battery there, under the desk.

Q. 43. How did you call up the operator at the other end of the line, when you used the snuff box instrument?

A. We took the Morse telegraph instrument.

Q. 44. You had a Morse telegraph instrument then, in the office, as well as the telephone, had you?

A. Yes, sir.

Q. 45. Do you remember the appearance of Mr. Drawbaugh's instrument that he brought there to Mr. Stees' office and tried on the line that day?

A. Yes, sir.

Q. 46. What sort of a looking instrument was it?

A. A square walnut box, or very near square, with a place to speak in—a mouth piece, I suppose you would call it.

Q. 47. Please look at the exhibits in this case, and see if you recognize any of the instruments as having ever been seen by you?

Objected to, no sufficient foundation for this question having yet been laid.

(Witness is shown the exhibits by the examiner, and picks out instrument "J".)

Q. 48. While this instrument "J" was at Mr. Stees' shop, in the spring of 1878, did you open it and look inside of it, or not?

Objected as leading.

A. Yes, sir; out of curiosity.

Q. 49. Please examine the inside of the instrument now, and see if you find anything that you remember seeing there in the spring of 1878, either in the box or on the door?

A. I saw those little tin things that are inside of the box (indicating the tin straps enclosing the induction coils); I tried to see what this thing in front was (pointing to the diaphragm as visible through the mouth-piece, from the front of the instrument); I put my finger into the hole,

but didn't succeed in finding out what it was; I didn't like to tamper with it.

Q. 50. What particular thing did you want to see, if anything, when you opened the instrument to look at the inside?

A. I wanted to see how the sound could be made by that thing inside—that soft substance; it felt soft then when I put my finger into the mouth-piece, as if you were pushing against gutta percha.

Q. 51. Just point out to the examiner what part you mean?

A. This (putting his finger through the opening of the mouth-piece and pressing against the diaphragm).

Q. 52. When you opened the instrument to examine for this thing, what prevented you from satisfying yourself about it?

Objected to as incompetent, in view of interrogatory 49, asking the witness to point out what he remembers having seen in the interior of the box, and of his answer to that question.

A. The work that was inside—brass work.

Q. 53. How did that brass work compare with the brass work now on the inside of the instrument, so far as you remember?

Objected to as leading and as incompetent in view of interrogatory 49 and answer.

A. I can't recollect, definitely, but think it was similar.

Q. 54. Do you recollect anything about any accident happening to Mr. Drawbaugh's telephone while it was there at Mr. Stees' office, that spring?

A. No, sir; I don't.

Q. 55. Who was present that day when you and Mr. Drawbaugh and Harry Stees were testing the Drawbaugh telephone over the line?

A. Only the three of us.

Q. 56. Had you ever heard anything before that about Mr. Drawbaugh having a telephone?

Objected to as calling for hearsay, and as assuming and leading.

A. Yes, sir.

Q. 57. Who told you about it before that, and how long before?

Objection continued.

A. Mr. Stees; but I don't recollect the time.

Q. 58. You have stated that you were employed at Mr. Stees' office twice, to wit: once in the spring of 1878, as you have described, and once on some other occasion; when was that other occasion?

A. 1880.

Q. 59. About what time in 1880?

A. I think about February or March somewheres.

Q. 60. Do you remember what kind of a telephone instrument Mr. Stees had in his office when you were employed there in 1880?

A. I don't recollect the name; it was a long box with a little desk on the lower part of it, and he used a bell on it.

Q. 61. Was there any such box as that in Mr. Stees' office when Mr. Drawbaugh had his telephone there?

A. No, sir.

Q. 62. When Mr. Stees had this long box telephone there in 1880, were any of these snuff box instruments used with it, so far as you remember?

A. No, sir; not to my recollection.

JAMES J. JOHNSON.

Witness signs deposition as a precaution.

Adjourned until March 10th, 1885, at 10 A. M.

March 10, 1885, 9 P. M.

Examination of James H. Johnson resumed, the deposition of Harry H. Stees having been taken in the meantime.

Present: Same counsel.

Cross-examined by Mr. Howson:

X-Q. 63. For how long before April, 1884, were you residing in Harrisburg?

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A. We moved there in 1869 or 1870; I am not certain which—somewhere in that neighborhood.

X-Q. 64. Do you mean by that, that you were living here continuously from 1869 or 1870 down until April 1884?

A. Not exactly; my home was here, but I have been away a few months at a time.

X-Q. 65. What time yesterday did you arrive here to give your testimony?

A. At three o'clock in the afternoon.

X-Q. 66. Who asked you to come here, or first saw you on the subject?

A. I first received a telegram signed by Judge Hill and H. H. Stees.

X-Q. 67. You say you arrived here at three on the afternoon; your examination began at 7 or 8 in the evening; where were you in the meantime, and with whom?

A. I was in lawyer Jacob's office, with him and Judge Hill and Mr. H. H. Stees; I also visited the Harrisburg Car Company's office and examined the books to satisfy my memory, and filled most of the rest of my time eating supper.

X-Q. 68. In your direct examination you have stated, that after leaving the employ of Mr. Stees in 1878 you went into that of the Union Transfer Company at Philadelphia; can you now state more particularly than you did in your direct examination, the time when you went into the latter employment?

A. The time was somewhere between the first of June and the fourth of July, 1878; but the Transfer Company's books would show it.

X-Q. 69. What were you doing immediately before going to Philadelphia?

A. I done nothing that I can recollect between working for Mr. Stees and going to Philadelphia.

X-Q. 70. When, according to your present recollection, was it that you quit working for Mr. Stees that time?

A. I cannot recollect the exact time, but I gave up the

books, as near as I can recollect, in May, somewheres from the 7th to the 11th; after that I collected some outside bills for a while, but cannot state the time.

X-Q. 71. Your memory about this matter of collecting bills seems to be somewhat more definite this evening than it was last evening when you gave your answer to interrogatory 5, which the examiner will read to you; I will now ask you to state, as near as your memory will allow, how long you were engaged in collecting bills for Mr. Stees after you had given up the books in the spring of 1878, and what particular work of the kind you now recollect doing for Mr. Stees during that time?

Preamble to the question objected to as not justified by anything to be found in the witness' fifth answer.

A. The answer I gave this evening I only meant for the work I did in collecting bills after I quit the work at that particular time, in the spring of 1878; the answer I gave last night, was for odd jobs that I did a week or so at a time, it may have been before or after, I can't say which time; when I was collecting bills for Mr. Stees in the spring of 1878, after I gave up the books, may have been one week, or it may have been three; I can't definitely recollect the length of time; the work was such as collecting bills for lumber furnished.

X-Q. 72. Did you yesterday examine the time book of the Harrisburg Car Company's saw mill; and if so, over what period did your examination extend?

A. No, sir; not the time book; but I examined the day book of 1878, between February and May.

X-Q. 73. After you went to Philadelphia that spring, how long did you stay there?

A. Till the first of October, as near as I can recollect.

X-Q. 74. Where were you and what were you doing between October, 1878, and February, 1880?

A. I worked for the Harrisburg Car Company, in the capacity of building freight cars; I also worked at my trade in Philadelphia between those periods.

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X-Q. 75. During what part of the period was it that you were at work here in Harrisburg?

A. I think it was the latter part of 1878, and it may have been a month or so of 1879; I couldn't state exactly.

X-Q. 76. Where were you and what doing in May, 1879?

A. I think, as near as I can recollect, I was building cars up at the upper car shops, Harrisburg, then.

X-Q. 77. I am informed that on the time book of the Harrisburg Car Company's saw mill, it appears that a "J. Johnson" was at work there on the 5th and 6th of May, 1879; have you any recollection of being there at or about that time?

Objected to as based entirely upon a matter of which there is no proof in this case, and assuming to cross-examine upon allegations as to the contents of books that are not produced; and as otherwise incompetent and improper.

A. If the books so state as I before stated, I done odd jobs of collecting—sometimes a week or two weeks—and I can't recollect the times; this may have been one of them.

X-Q. 78. Who kept that time book while you were there in the spring of 1878, and again in the spring of 1880?

A. Sometimes Mr. Stees filled it out; and, perhaps, I did too; I can't say, but I think that I have.

X-Q. 79. You are familiar, I suppose, with the handwriting of Mr. Stees and of his son, H. H. Stees?

A. Yes, sir; I would know their signatures, at least.

X-Q. 80. Will you please look at the book which I now hand you, and say if you know what it is?

A. Yes, sir; it is the time book of the Harrisburg Car Company's saw-mill.

X-Q. 81. Will you please now look at the entries in this book for April and May, 1879, and say whether you do not find your name there as having worked there for a day and a half on the 5th and 6th of May, 1879?

Objected to as immaterial.

A. I do.

X-Q. 82. As I understand you, you have not now the

slightest recollection of just what you were doing there then?

A. Not any more than what I stated before—odd jobs of collecting bills?

X-Q. 83. And when you were doing that kind of work, was your time taken like that of other employees?

A. Yes, sir.

X-Q. 84. This same book shows, does it not, that Mr. H. H. Stees was at work in the place on this same 5th and 6th of May, 1879?

A. Yes, sir.

X-Q. 85. Referring now to this same book for May, 1878, does not your name cease to appear on it on the 10th of that month?

A. Yes, sir; it is so here.

X-Q. 86. And the name of H. H. Stees first appears there on the same 10th of May, 1878; is not that the case?

A. Yes, sir.

X-Q. 87. Your memory does not enable you to mention now any other times during which you were at work for Mr. Stees, in the collection of bills, or other work?

A. Not other than I have already stated; except that I have a faint recollection of working for a short time prior to 1878, but I can't state what year.

X-Q. 88. When you arrived here yesterday afternoon, where did you first go to?

A. I came to Mr. Jacob's office.

X-Q. 89. And your meeting there with Messrs. Hill, Jacobs and Stees, was before you went to the Harrisburg Car Company's place and examined, as you have stated, the day-book for 1878, between February and May; is that correct?

A. Yes, sir.

Re-direct by Mr. Hill:

Q. 90. Inasmuch as the time book shows that you were employed at the saw-mill a day and a half in May, 1879, and that Harry Stees was employed there at the same time, I will

now ask you whether or not that was the time when Mr. Drawbaugh had his instrument over at Mr. Stees' office and had it tested there?

Objected to inasmuch as the witness has already admitted that his memory is blank as to the time inquired of.

Mr. Hill replies to the objection, that the conclusion by no means follows; that the witness' memory may be a blank as to what he was doing on the 5th and 6th of May, 1879, but on the contrary, may be very far from blank as to what he was doing when the Drawbaugh instrument was at the shop, and as to the time of that event.

Complainants' counsel objects to hints and instructions to the witness under the guise of a reply to an objection.

Mr. Hill replies that he has not intended to instruuct the witness, but as Mr. Howson saw fit to put an argument upon the record, Mr. Hill saw fit to put his reply to it, where both would be likely to be read together.

A. No, sir; it was not the time.

Q. 91. Why did you examine the day book rather than the time book, yesterday?

A. To satisfy my memory as to whether I kept the books in 1878 or 1879, as I remembered that that was the time the instrument was there at the office.

Q. 92. Do you mean that the time you kept the books was the time the instrument was there?

Objected to as leading.

A. Yes, sir.

Q. 93. Before you went to see the books yesterday, did you not tell Mr. Hill and Mr. Jacobs that the spring of 1878 was the spring when you kept the books and saw the Drawbaugh machine there?

Objected to as leading and incompetent.

A. Yes, sir; I also said that I would be better satisfied if I could see the day book.

Q. 94. And then Mr. Hill requested you to go and look at the books; did he not?

A. Yes, sir.

Q. 95. And did you find that the books corroborated what you had already told Mr. Hill about the dates?

Objected to as incompetent.

A. Yes, sir.

Re-cross by Mr. Howson:

X-Q. 96. Did you continue to keep the books after Mr. H. H. Stees' return to work that spring?

A. No, sir.

X-Q. 97. You have referred to working for the elder Mr. Stees in the spring of 1880; how early did you work for him in the spring of 1880?

A. I can't definitely say, but think it was somewheres in the neighborhood of six or ten weeks.

X-Q. 98. Was Mr. H. H. Stees present or absent during the time you were working there that spring?

A. He was absent when I went there.

X-Q. 99. During his absence, what were you doing there?

A. Helping to keep the books, the same as in 1878.

X-Q. 100. You say Mr. H. H. Stees was absent when you went there; during how much of the time, according to your present reccollection, was he present on that occasion?

A. As near as I can recollect, he was present something like a week or two; it might be more, or less.

X-Q. 101. When he was there, were you or he keeping the books on that occasion?

A. I think he was keeping the books—doing the writing; I remember at one time helping to get up a balance sheet; I think that was the time; I am not sure.

X-Q. 102. What else did you do during the week or two that you and he were there together?

A. I can't recollect; I may have collected some bills; I remember we got a lot of timber by freight once, and we had to take account of that.

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X-Q. 103. Referring to the time book again, you find it to show, do you not, that you were at work there on that occasion from the 20th of February till the 20th of March, 1880, and that you and Mr. H. H. Stees were at work there together from the 10th to the 20th of March?

A. Yes, sir.

Re-direct by Mr. Hill:

Q. 104. Was that the time when Mr. Drawbaugh had his telephone over there at Mr. Stees' office?

Objected to as incompetent.

A. No, sir.

JAMES J. JOHNSON.

Sworn and subscribed to before me this 10th day of March, 1885.

FRED. M. OTT,
Special Examiner.

Adjourned until March 11th, 1885, at 10 A. M.

March 10th, 1885, 12.30 P. M.

Examination resumed.

Present: Same counsel.

Harry H. Stees being produced, sworn and examined, saith:

Examined by Mr. Hill:

My age is almost twenty-nine years; residence, 104 Walnut street, Harrisburg, Penna.; occupation, newpaper reporter; I have been a book-keeper.

Q. 1. What was your father's name?

A. William J. Stees.

Q. 2. Is your father living; and if not, when did he die?

A. He is dead; he died on the 20th day of May, 1881.

Q. 3. Was he the Mr. Stees who was killed by a locomotive in the streets of this city?

A. Yes, sir.

Q. 4. What was his business?

A. He was superintendent of the Harrisburg Car Company's saw mill.

Q. 5. Where was his office?

A. Right above Vine street, Harrisburg, along the Pennsylvania railroad.

Q. 6. Did he have a telephone line or lines connected with his office; and if so, where did the line or lines run to from his office?

A. The Harrisburg foundry and machine works, Harrisburg car shops, W. T. Hildrop's house, and to George Boyer's house.

Q. 7. Please look at the two instruments which I now show you, which were used as exhibits in the case of the American Bell Telephone Company vs. The People's Telephone Company in the United States Circuit Court for the Southern District of New York, one of them marked "Complainant's Exhibit Phelps' Snuff-box Telephone", and the other marked "Complainant's Exhibit Phelps' Crown Telephone"; and state when and where you first saw telephone instruments of these two forms?

A. Right in the office of the Harrisburg Car Company's saw mill in 1878.

Q. 8. Which of these two forms did you see there first?

A. This was the one we used first (indicating Phelps' snuff-box telephone).

Q. 9. Do you remember about what time you first saw the Phelps' crown telephone there?

A. It was in the winter of 1878.

Q. 10. What is your recollection as to how early the snuff-box instrument was used there?

A. We had it in there in 1877—the fall of 1877.

Q. 11. Was the Blake transmitter ever put into your father's office there?

A. It was in 1880.

Q. 12. Do you remember who brought it there, and put it up?

A. Clute brought it there and put it up.

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1756

Q. 13. Clute was the superintendent of the telephone company or telegraph company here about that time, was he not? I mean the superintendent of their office here?

A. Yes, sir.

Q. 14. Were these instruments of the snuff box form and crown form used in your father's office.

A. Yes, sir.

Q. 15. When you used these two instruments, the snuff box and crown, at your father's office, how did you call up the operator at the other end of the line?

A. With a Morse telegraph instrument.

Q. 16. Did you have a battery connected with the Morse telegraph instrument there?

A. Yes, sir.

Q. 17. Was there a battery connected with the telephone line there when you used the snuff box and crown form of telephone?

A. Yes, sir; there was a battery connected with the telegraph; there were three jars, and the telephone was connected or worked from the jar at the furthest end of the room towards the wall.

Q. 18. Where were you in the spring of 1878?

A. I left in the spring of 1878, on the night of the 21st of March for Des Moines, Iowa; I then left Des Moines, Iowa, and came back to Chicago, and remained till the 7th day of May, 1878; I then left the night of the 7th day May, which was Sunday, and arrived here on Monday night, on mail express at 11.15.

Q. 19. Have you any letter or any other paper here to confirm your recollection as to the year and the season that you were in the West?

A. Yes, sir; I have here a letter (witness produces letter.)

Respondent's counsel offers the letter and envelope in evidence as "Exhibit Stees' letter and envelope"; and at his request the examiner certifies that the letter is dated "Harrisburg, April 29th, 1878"; and addressed, "Dear Harry", while the envelope is

addressed to "Mr. Harry H. Stees, No. 59 North Lincoln st., Chicago, Illinois", and is post-marked "Harrisburg, Pa., Apr. '29, 7 P. M", and is stamped on the back in red ink, "Chicago, Ill., 9 A. M., May 1, Carrier".

Q. 20. Did you receive this letter in regular course of the mail while you were in the West?

A. Yes, sir.

Q. 21. Before you went west that year, where and how were you employed?

A. I was employed as a bookkeeper at the Harrisburg Car Company's saw mill.

Q. 22. In your father's office there?

A. In my father's office, yes, sir.

Q. 23. After your return from the west, where and how were you employed first?

A. I staid around here three days and then went to work again for my father.

Q. 24. Who occupied your position as bookkeeper during your absence in the west that spring?

A. My cousin, James H. Johnson.

Q. 25. Do you know Daniel Drawbaugh, of Eberly's Mills, Cumberland county?

A. I do.

Q. 26. Were you ever in his shop at Eberly's Mills?

A. I have been in his shop quite frequently.

Q. 27. Did you ever see any talking machines in his shop?

Objected to as leading.

A. Yes, sir.

Q. 28. Can you tell us about when it was that you first saw any talking machines in his shop?

A. It was the latter part of August, 1870.

Q. 29. Who was present in the shop at the time?

A. My father, Drawbaugh and myself.

Q. 30. Was anything done with the talking machines there that day, while you were present; if so, what?

A. They talked through them.

Q. 31. Was that the first that you had ever known of Mr. Drawbaugh's talking machines?

A. No, sir.

Q. 32. What had you known of Mr. Drawbaugh's talking machines before that time?

A. I heard my father talk, and tell me that Drawbaugh had a machine working there in 1868.

Answer objected to by Mr. Howson as hearsay.

Q. 33. Will you state whether or not Mr. Drawbaugh ever had one of his talking machines or telephones at your father's office, here in Harrisburg?

A. Yes, sir; he had.

Q. 34. Who brought it to your father's office?

A. Drawbaugh himself.

Q. 35. Who was present in your father's office when he brought it there?

A. Johnson, my father and myself.

Q. 36. How long did that machine remain in your father's office?

A. Well on to three months.

Q. 37. About what time did Mr. Drawbaugh bring that machine to your father's office?

A. It was brought there on the 10th day of May, 1878.

Q. 38. How do you fix the date?

A. I came home here on the night of the 8th day of May, and on Wednesday morning he brought it there—the 10th day of May.

Q. 39. What, if anything, was done with the telephone that Drawbaugh brought to your father's office about the 10th day of May, 1878?

A. On the 12th day of May, Drawbaugh put it up, and we tested it, and it worked splendidly.

Q. 40. How did you test it?

A. We worked it between the Harrisburg Car Company's saw-mill and the Harrisburg foundry and machine-works on the hill.

Q. 41. Was your father's office at the saw-mill?

A. Yes, sir; the office was out at the railroad and the saw-mill was back at the canal about two squares distant.

Q. 42. When you say that you worked the instrument from the saw-mill to the Harrisburg foundry and machine-works, do you mean that you worked it from you father's office or from the saw-mill itself?

A. From the office.

Q. 43. How long was the line from the office to the Car Company's foundry and machine-shop?

A. One mile.

Q. 44. In making that test that day with the Drawbaugh instrument on the line, who talked into the Drawbaugh instrument?

A. I did.

Q. 45. Do you know who was at the other end of the line, at the machine shop?

A. I do not; I can't remember.

Q. 46. Did anybody operate a telephone receiver in your office that day during the tests, to receive back from the operator at the other end of the line?

A. Yes, sir.

Q. 47. Who operated the receiver?

A. Johnson.

Q. 48. Do you remember what form of instrument he used as a receiver that day during the tests?

A. The "snuff-box."

Q. 49. When you were talking into the Drawbaugh telephone that day at your office, how far did you stand from the transmitter?

A. As far as from this table to the door, and a little bit further.

The examiner certifies that the distance indicated is about ten feet.

Q. 50. Do you mean that you were all the time as far as that from the transmitter?

A. No, sir; I went gradually away from it, backward.

Q. 51. What sort of looking instrument was that Drawbaugh instrument that you tested that day?

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A. It was a box about that big (indicating about eleven inches), and about that square (indicating about six inches).

Q. 52. Did you see the inside of it while it was at your father's office that spring or summer?

A. Yes, sir.

Q. 53. Did anything happen to that instrument while it was there at your father's office that spring or summer?

A. Yes, sir.

Q. 54. What happened to it?

A. It was knocked out of my hands by my father, and the carbon knocked out.

Q. 55. Did it fall on the floor when it was knocked out of your hands?

A. Yes, sir.

Q. 56. How happened your father to knock it out of your hands?

A. I had it in my left hand and he struck my arm accidentally.

Q. 57. When did you find that the carbons had been knocked out of it by its fall?

A. I looked at it the next day and found them out; then I looked for the carbons, but could not find them.

Q. 58. Did Drawbaugh have any other telephone at your father's office at any time?

A. Yes, sir.

Q. 59. When?

A. The same year.

Q. 60. Before, or after he had this large instrument there, that you have been speaking about?

A. After.

Q. 61. What kind of a looking instrument was this last instrument that he had there?

A. A round one.

Q. 62. Do you think you could recognize those two instruments that Drawbaugh had at your father's office, if you should see them again?

A. Yes, sir.

Q. 63. Will you please go with the examiner to his room,

look at the exhibits there in his possession, and see if you find those two instruments there among them, and if you do, bring them up here to this room?

A. Yes, sir.

Witness and examiner proceed to the examiner's room, and witness selects instruments "J" and "N".

Q. 64. Which of these two instruments is the one that was tested at your father's office, as you have described?

A. This one, (indicating "J").

Q. 65. Point out in this instrument any parts that you remember being in the instrument when it was at your father's office, in the spring or summer of 1878?

Objected to as leading, the witness not having given, nor having been asked to give, any description of the instrument or its details from memory.

A. This whole thing was in it, (indicating the parts supported by the inner side of the door). These coils were both in, (indicating the induction coils in the bottom of the box). These switches inside of the box were there, (indicating the switches just above the induction coils). And these switches on the outside were there.

Q. 66. When Drawbaugh had this small instrument "N", at your father's office, do you remember whether it was tested or operated there, or not?

A. I do not know whether it was tested or not; it was brought there and left there.

Q. 67. Do you know how long it remained there?

A. About a month and a half.

Q. 68. In what season of the year was it that that small instrument was in your father's office?

A. In August.

Q. 69. Who took this large instrument "J" away from your father's office?

A. Drawbaugh.

Q. 70. When you returned home from Chicago in the spring of 1878, I understood you that you left Chicago Sunday evening?

A. Yes, sir; that was the seventh, wasn't it?

Q. 71. By reference to the calendar of 1878 I find that the first Sunday of May that year was the fifth day of the month; in view of this fact, are you able to state what day of the month it was that you left Chicago?

A. I am.

Q. 73. What day of the month do you now fix as the day of your leaving Chicago?

A. I left Chicago on the seventh day of the month, and I know it; and I will tell where I got it on a Sunday; Mr. Jacobs said last night when he looked at the calender that the seventh was on Sunday, and I thought he was wrong then.

Cross-examination by Mr. Howson:

X-Q. 74. When and where did you last act as a bookkeeper?

A. At the Harrisburg Car Company's saw mill in 1881.

X-Q 75. When did your father die?

A. The 20th day of May; the same day I quit.

X-Q. 76. For what paper are you now reporting?

A. The *Harrisburg Morning Call.*

X-Q. 77. How long have you been reporting for that paper?

A. Two months—since it started.

X-Q. 78. What was your occupation before that time?

A. I done nothing, previous to that, but travel the country, from 1881 till January.

X-Q. 79. Travelling the country on business; and if yes, in what business?

A. I was travelling around for pleasure among my own relations in the western states.

X-Q. 80. While you were acting as bookkeeper in your father's office, what was your salary there?

A. Twenty-five dollars a month and my board.

X-Q. 81. Whereabouts in the west were you travelling during the four years or thereabouts, for which you say that was your sole occupation?

A. To Chicago, La Place ; Des Moines, Iowa ; Newton, Iowa, and Omaha.

X-Q. 82. I suppose you were at home here in Harrisburg from time to time during that period ?

A. Yes, sir ; I have been home since last August here in town.

X-Q. 83. With whom have you your residence in this city ?

A. My mother.

X-Q. 84. And how long has she been living at No. 104 Walnut street ?

A. Ever since I can remember anything.

X-Q. 85. Were you not at home from time to time between the commencement of your travels in the West and August of last year ?

A. Yes, sir ; I was.

X-Q. 86. During that time, were you most in the West, or in Harrisburg here ?

A. I went West in May, 1882, and returned in September, 1882, and staid here till December—Christmas night—of 1882, and went back to Chicago and staid till the following April ; I then came home and staid till March, 1884 ; and then went back to Chicago and remained till August.

X-Q. 87. If I understand your testimony then, you were at home here during the winters of 1880—1, 1881—2, and 1883—4 ; is that correct ?

A. That is correct.

X-Q. 88. I understand from your testimony in chief that you had a talk last evening with defendant's counsel, Mr. Jacobs, in his office ; who else was present during that conference, if anyone ?

A. There was no one present ; I don't know as we had any great talk about anything.

X-Q. 89. I understand you now to say that upon your return home from Chicago in the spring of 1878, you left Chicago on Tuesday night, and not on Sunday night as you at first stated ; is that correct ?

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A. I left Chicago Tuesday night; I left Chicago on the 7th of May, whatever day that was.

X-Q. 90. I also understand you to say that you arrived at Harrisburg the next evening; how soon after that, did you return to your work?

A. I went to work on the 12th—three days after I returned—I returned on the 8th—and went to work on the 11th.

X-Q. 91. Where were you and what doing, during the two days intervening between the evening of your return and the morning of your going to work?

A. I was down around the mill and around the town.

X-Q. 92. Were you in the office most of the time during those two days?

A. I was in the office—in and out of the office three or four times in a day.

X-Q. 93. On matters connected with business, or for your own entertainment?

A. It was for my own pleasing; I wasn't connected with business.

X-Q. 94. How soon after your return to work did Mr. Johnson, who had been taking your place, quit?

A. He collected bills for my father, and done a little outside work for him, up to the first of June, when he went on the road.

X-Q. 95. Was he under salary during that period; and if so, what salary was he getting?

A. He was working on commission.

X-Q. 96. You say that he worked that way until he worked on the road—what road?

A. The Pennsylvania railroad.

X-Q. 97. In what capacity, if you know?

A. Transfer agent.

X-Q. 98. How long, or about how long, was it that the instrument which you think was exhibit "J" remained in your father's office?

A. Three months.

X-Q. 99. Whereabouts in the office was it during that time?

A. That is more than I can tell you—whereabouts it was all the time.

X-Q. 100. How soon after your return was it, according to your best recollection, that the instrument was brought to your place?

A. It was brought there in May, and put up and tested on the 12th day of May.

X-Q. 101. I ask you again, how long a time, according to the best of your recollection, elapsed between the time of your coming back to work and the bringing of exhibit "J" to your place?

A. I am not able to say how long a time it was.

Defendants' counsel asks if the witness understands the question.

Witness asks what the question is.

Question re-read to witness.

A. I came back there on the 11th and the instrument was there when I got there; it had been there two or three days before I got there—laying there—and Drawbaugh came over and put it up on the 12th.

X-Q. 102. By what particular features do you think you recognize exhibit "N"?

A. I have examined it all over—took it apart and examined it.

X-Q. 103. When did you do that?

A. When it was there at the office; I couldn't tell you just exactly what time I did it, but I did it.

X-Q. 104. Please tell us just how you went to work to take it all apart and examine it?

A. I unscrewed the top off—took the top off (indicating the portion with the mouth-piece on).

X-Q. 105. How soon was that after it came to the place?

A. That I couldn't tell you, how soon it was; I didn't take account of that; it was while it was at the place, any way.

X-Q. 106. Who was present at the time you did this?

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A. No person; I was in the office alone; my father came in after I had it apart.

X-Q. 107. When last had you the top of the mouth-piece unscrewed?

A. That I don't know—in 1878—the same year that other instrument was there.

(The examiner certifies that the top and mouth-piece of instrument "N" is now attached to the body of the instrument by two screws, and that it was in that condition when the witness picked it out.)

X-Q. 108. Were you present when the instrument which you think was exhibit "N" was brought to the place?

A. No, sir; I was not.

X-Q. 109. Were you present when it was taken away from the place?

A. I was; it was taken away by Drawbaugh himself.

X-Q. 110. About what time was that, as you now recollect?

A. I can't recollect what time it was; that instrument was there about a month and a half.

X-Q. 111. Were you present when exhibit "J" was taken away from the place?

A. I suppose I was.

X-Q. 112. Do you know whether you were or not?

A. I do; yes, I was there.

X-Q. 113. Who was present when this instrument which you think was exhibit "J" was tested, as you have stated?

A. Drawbaugh, my father, Johnson, and myself.

X-Q. 114. And you are just as clear about that as you are about anything else?

A. I am; I am certain of it.

X-Q. 115. What was going on in the office that day?

A. There was nothing special going on that day; nothing but what went on every day.

X-Q. 116. How long a time was there between the time the instrument was brought there and the time it was tested?

A. I couldn't tell you; but the instrument was tested on the 12th day of May.

X-Q. 117. And you are just as certain about that as you are about anything else you have said, are you?

A. I am certain it was the 12th day of May, and no other day.

X-Q. 118. During the time "J" was in the place, was it tested, to your knowledge, more than once?

A. No, sir; it was only tested once.

X-Q. 119. You have stated in your direct examination that Mr. Drawbaugh brought the instrument which you say was exhibit "J" to the office; do you remember what time of day it was, and who was present at the time?

A. It was near dinner time; my father and I were together.

Re-direct by Mr. Hill:

Q. 120. I understand you to think that you resumed work in your father's office on the 11th day of May, 1878; am I correct?

A. Yes, sir; I think that was the day?

Q. 121. And you think that the test was made on the 12th?

Objected to as leading.

A. Yes, sir.

Q. 122. How do you get at the 12th as the day on which the test was made?

A. I know it was the 12th, or about the 12th, because it was done the next day after I went to work.

Q. 123. Was the test made on a week day or Sunday?

A. It was made on a week day.

Q. 124. Do you think it was made on the second day after you resumed work?

A. It was made the next day, or the day after; I don't know which. It was either made on the 12th or the 13th. The 11th was Saturday and the 12th would be Sunday; we didn't pay much attention to Sunday down there, because we were down there anyway on Sunday—when anything broke.

HARRY H. STEES.

Sworn and subscribed to before me this 10th day of March, 1885.

FRED M. OTT,
Special Examiner.

Recess until 9 P. M.

March 11, 1885, 11 A. M.

Examination resumed.
Present: same counsel.

Mrs. Elcinda Jane Drawbaugh being produced, affirmed and examined, saith:

Examined by Mr. Hill:

I am the wife of Daniel Drawbaugh, of Eberly's Mills, Cumberland county, Pa.

Q. 1. When were you married to Mr. Drawbaugh?

A. It was thirty years on last New Year's evening, 1885.

Q. 2. Do you remember ever talking through your husband's talking machine?

A. Yes, sir.

Q. 3. Will you tell me on what occasion you first talked through the talking machine, so far as you remember?

A. I talked into the machine shortly after the birth of my son Charles, when he was about two weeks old in September, 1872.

Q. 4. Where was that?

A. It was in our own house, near the blacksmith shop.

Q. 5. Were you on the lower floor of the house or on the upper floor?

A. On the second floor.

Q. 6. Will you describe the occurrence, briefly?

A. I was in bed at the time, and Mr. Drawbaugh brought the machine to me. He asked me to listen, and also to talk into the machine. He went down stairs. He had told me that if I would listen, I could hear what he would say. He had one part of the machine down stairs with him, and I had

the other in bed. He had wire extending from one to the other—down a stove pipe hole in the floor.

Q. 7. Did you listen at the machine?

A. Yes, sir.

Q. 8. Did you hear what he said through the machine, or not?

A. Yes, sir.

Q. 9. Did you talk to him through the machine, or not?

A. Yes, sir; I talked to him through the machine.

Q. 10. Do you remember anything that you said to him through the machine?

A. Yes, sir.

Q. 11. State what it was, so far you remember it?

A. I told him I would like to have a piece of bread.

Q. 12. What did he do then, if anything?

A. He told me "this is the talking machine; what do you think of it?" That is what he said.

Q. 13. Did you get the piece of bread?

Objected as leading.

A. Yes, sir.

Q. 14. How did you get it?

A. He fetched it up to me.

Q. 15. Where were you living when you first heard anything about your husband's talking machine?

A. Living in Mr. Eberly's house, right back of the grist-mill.

Q. 16. You kept some boarders, I believe, while you lived in that house, did you not; or was it after you moved to the house near the blacksmith shop?

A. After we moved to the house near the blacksmith shop.

Q. 17. Your boarders were some of the men who worked for the faucet company, were they not?

A. Yes, sir.

Q. 18. When they were boarding with you, do you remember whether the talking machine was, or was not, a subject of more or less conversation among the boarders in your family?

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Objected to as leading.

A. Yes, sir; it was.

Q. 19. During the time that Mr. Drawbaugh was working on talking machines, from the beginning of them down to the time of the suit with the Bell Telephone Company, did you favor or oppose Mr. Drawbaugh in such work?

A. I opposed him.

Q. 20. Did you ever try to get him to stop such work and go to work at other things; if so, what did you say to him?

A. Yes, sir, I did; I told him it would be poorhouse with him.

Q. 21. How often did you try to persuade him to abandon this talking machine work?

A. Every time I heard him speak of the talking machine.

Q. 22. From the time when the old faucet company stopped work, about 1869 or 1870, down to the summer of 1880, what was Mr. Drawbaugh's financial condition?

A. He was poor.

Q. 23. During that period how were your family off for clothing and provisions and the necessaries of life?

A. We were poor.

Q. 24. Will you state any facts that will give us an idea of how poorly off the family were during that time?

A. Well, for the eating line, sometimes I had nothing but coffee and potatoes for breakfast, and nothing during the day, unless I went out and got it.

Q. 25. How about the matter of clothing?

A. We were in poor circumstances.

Q. 26. How poorly off at any time or times in respect to clothing?

A. He was very poor; sometimes he had to come to Harrisburg after dark—in the evening.

Q. 27. How did you manage to keep yourself and children clothed?

A. The better part of my children's good clothing was given to them—presents.

Q. 28. Do you recollect the constable's coming to your house, at any time, to levy on your furniture there?

A. Yes, sir.

Q. 29. Did you have any conversation with him at the time?

A. Yes, sir.

Q. 30. State what that conversation was?

Conversations between this witness and third parties objected to as immaterial and irrelevant, and not evidence for any purpose in this case.

A. I told him there was one room he should stay out of, as my daughter had an organ in there, and that he should not lay hands on it; my daughter was dead at the time—it being a present.

Q. 31. What was that daughter's name?

A. Emma C. Drawbaugh.

Q. 32. Why did you not want that organ touched?

A. It was the only piece of furniture in the house that I loved; I loved to hold it, and I was going to do so.

Q. 33. While your daughter Emma was living, do you remember whether or not Mr. Drawbaugh used to take her down to the shop with him?

A. Yes, sir.

Q. 34. How often and for what purpose did he take her down to the shop?

Objected to as incompetent.

A. Took her frequently, to hold the light, and also to talk in the machine.

Q. 35. How did you know that that was what he took her down to the shop for?

A. She would tell me so.

Answer objected to by Mr. Howson as not evidence.

Q. 36. How much was Mr. Drawbaugh in the habit of working at night in the shop?

A. Every night.

Q. 37. How often were you in the habit of visiting the shop?

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A. Not very often.

Q. 38. Give us a more definite idea, if you can, of how often?

A. Once in three or four years.

Q. 39. Was your husband a good business manager, or a poor one?

A. Very poor.

Q. 40. What was his habit about collecting debts due him, was he prompt about it or negligent?

A. Very negligent.

Q. 41. When he got any money, was he a man who would let it slip through his fingers, or hold on to it and use it carefully?

Objected to as incompetent.

A. He left it slip mostly.

Q. 42. When he was very poor himself, how was it if any one came to him and wanted money from him for charity or other purposes?

Objection continued.

A. He would give the last cent.

Q. 43. Before he sold the house and property at the blacksmith shop in Milltown to Mr. Fettrow, had he ever said anything to you about wanting to sell that property?

Objection continued, and also objected to as immaterial.

A. Yes, sir.

Q. 44. Once, or more than once?

A. Yes, sir; frequently.

Q. 45. Did he state why he wanted to sell it; if so, what reason did he give?

Objections renewed.

A. Yes, sir; he wanted to have the money, he said, to get his patent right and also to pay off his debts.

Q. 46. To get the patent right on what?

Objections continued.

A. On the talking machine, as he called it.

Q. 47. What did you say to him when he told you he wanted to sell the property for that purpose?

Objections continued.

A. I told him, "No, sir; unless you buy another one, you shall not sell this home".

Q. 48. Did you say anything to him about joining in the deed; if so, what?

Objections continued, and also objected to as leading.

A. I told him I would never sign my name to the deed, unless he would give me two hundred dollars out of it.

Q. 49. What did you want the two hundred dollars for?

Objections continued.

A. As we were moving into town, I wanted to clothe my children better and live a little better.

Q. 50. When he sold that property, he bought a home in Mechanicsburg out of the proceeds, did he not?

A. Yes, sir.

Q. 51. If he had not bought another home out of the proceeds of that property, would you have joined in the deed of the Milltown property, or not?

Objected to as argumentative and leading.

A. No, sir.

Q. 52. How much was your husband in debt, during the period from his working for the old faucet company to the summer of 1880?

Objected to as not seeking the best evidence.

A. I do not know.

Q. 53. Were you ever troubled or annoyed by creditors coming to the house to dun for payments, or not?

Objected to as leading.

A. Yes, sir.

Q. 54. How frequently?

A. Very often.

Q. 55. What did you used to say to Mr. Drawbaugh about it on such occasions?

Objected to as incompetent and immaterial.

A. Well, I would very often tell him that if he would lay that crazy machine away, and work at something else, he would avoid all the trouble.

Q. 56. Did you ever hear any complaints about his not doing jobs of work promptly when they were brought to him?

Objected to as leading and incompetent.

A. Yes, sir; very often.

Q. 57. Did you know, at the time, what the reason was why he didn't do his work more promptly?

A. Yes, sir.

Q. 58. State what it was, so far as you know?

A. He would always be inventing or working at something of the kind, and would leave the work lay.

Recess until 2 P. M.

Cross-examined by Mr. Howson:

X-Q. 58. In your examination in chief you have referred to a certain organ, which you say was a present; to whom and by whom was that organ presented, and when?

A. I can't exactly tell the year, but it was presented by me to my daughter—to my daughter Emma.

X-Q. 59. Upon the occasion of the constable's visit to which you have referred, or in consequence of it, were any goods actually removed from the house?

A. No, sir; not any.

X-Q. 60. I wish you would exercise your memory a little and tell us the year, or about the year, in which you gave the organ to your daughter Emma?

A. I received the money from my grandmother's estate, and I furnished the money for the organ, and I do not remember the date of the year.

X-Q. 61. You don't remember even about the year that you received the money from your grandmother's estate?

A. I couldn't just now; no, sir.

X-Q. 62. What was the amount of the money which you received from your grandmother's estate?

A. I can't tell just exactly how much it was, but it was somewheres near two hundred and fifty dollars; there was four or five children of us.

X-Q. 63. Please name the children referred to in the last answer, and tell me where they are now, if living?

Objected to as immaterial.

A. Two have since died; one is living in Oregon, named Theodore McHenry Thompson; one is living in the State of Ohio, named Annie E. Heck; one is living out near Stroudsburg, Penna., named Mary Ellen Keene.

X-Q. 64. How old, or about how old was your daughter Emma, when this organ was bought?

A. I can't exactly answer that.

X-Q. 65. When did she die, and at what age?

A. She was fifteen years old when she died; she died the year we lived in the Fettrow house; she died of scarlet fever.

X-Q. 66. I find that she died the 18th of November, 1871; can you tell me how long, or about how long, the organ had been in the house at that time?

A. Not exactly, I can't—somewheres in the neighborhood of ten or eleven years, or may be more.

X-Q. 67. According to your present recollection, then, this organ was presented to your daughter when she was about four or five years old; is that the case?

A. Yes, sir; she was quite young.

X-Q. 68. Can you tell me when and from whom it was bought?

A. I do not recollect the man's name; it was bought here in Harrisburg.

X-Q. 69. Do you recollect whose make of organ it was?

A. Indeed, I do not; we traded that one off after she died; I don't remember the name of it.

X-Q. 70. When was it that you traded that one off, and for what did you trade it off?

A. We traded it off some five years ago to Mr. Dinkle, of Carlisle, for another organ; I may not be positive on the date; I am poor on that.

X-Q. 71. In your examination in chief, you were questioned as to your husband's financial condition from about 1869 or 1870 down to the summer of 1880, and among

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other statements you made on the subject, was that the better part of your children's good clothing was given to them, presented; do you intend to have that statement understood as applying to the whole time from 1869 or 1870 down to 1880?

A. From the time they had grown up to be twelve or thirteen years old, I do.

Q. 72. What part of the time from 1869 or 1870, down to 1880, would that cover?

A. I don't know as I could answer that exactly.

X-Q. 73. How many of your children received the better part of their good clothing in that way?

A. Well, sometimes they all got a present of a new dress or a new pair of shoes, or underclothing, not necessary to mention.

X-Q. 74. It was quite a common thing, was it, for them to receive presents of the kind?

A. Yes, sir.

X-Q. 75. Who was the person, or who were the persons, in the habit of making these presents to your children?

A. Mrs. Oyster, a sister of Mr. Drawbaugh, who was living in Le Grange, in the West; and there was a gentleman, who boarded with me, who bought my daughter Emma several dresses.

X-Q. 76. Who was the gentleman, and how long did he board with you?

A. I don't know how long he boarded with me; but his name was Eggborn, a Swede.

X-Q. 77. When was it that this Mr. Eggborn was boarding with you?

A. It was the time I was having the boarders, at the Fettrow house.

X-Q. 78. It was while he was boarding with you, I suppose, that he made these presents to which you refer?

A. Yes, sir.

X-Q. 79. You can't give me any idea how long he boarded with you, can you?

A. No, sir; I cannot; he was of a drinking character, and I wouldn't have him.

X-Q. 80. I presume from your last answer then, that Mr. Eggborn was with you only a short time?

A. Some few months.

X-Q. 81. You have no recollection what year it was?

A. It was in 1878 or 1879, I think—1868 or 1869 I mean; it was the year I boarded the men.

X-Q. 82. You have referred to a house you call the Fettrow house; how long were you living in that house?

A. Perhaps six or seven years.

X-Q. 83. You have now given me, have you, the names of all the persons whom you think of at present as having been accustomed to make presents of clothing to your children?

A. There may be some that I have not given. It is not necessary to give every point. I don't consider a calico dress good clothing. What I mean was costly clothing—a dollar a yard, or fifty cents a yard; the other I don't take account of.

X-Q. 84. The presents of clothing from Mrs. Oyster were quite frequent, were they?

A. Well, they were at visits, she would pay me and would leave presents; and she frequently sent money to the children, that they bought clothing with.

X-Q. 85. How frequently between 1869 or 1870 and 1880 did Mrs. Oyster visit you?

A. She paid me but one visit during this time.

X-Q. 86. Will you please tell me, as near as you can, when that one visit was?

A. No, sir; I can't tell exactly; she has been visiting us since that time.

X-Q. 87. Referring now to the time when, as you have stated, your husband talked to you and you talked to him, through a talking machine; you were yet confined to your bed, as I understand you, at that time?

A. Yes, sir.

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X-Q. 88. Where was the machine that you used on that occasion?

A. He fetched it up to the bed to me.

X-Q. 89. How did you manage to use it?

A. Well, he told me that I should hold it to my ear, and he would go down and talk to me.

X-Q. 90. What was your position while you held it to your ear?

A. He helped me to sit up in the bed, and I was sitting up.

X-Q. 91. And while sitting up you lifted the machine to your ear, and held it there; is that it.

A. Yes, sir.

X-Q. 92. What is the situation of the room in which that occurred; what was immediately below the room at that time?

A. We generally cooked and eat below that room; the sleeping room that I occupied was right above.

X-Q. 93. The room you occupied, then, if I understand you, was the room directly above the kitchen?

A. Yes, sir.

X-Q. 94. What time of year was it, that your son Charles was born?

A. He was born in 1872; it was in the month of September, or whatever I said before—I get a little heart disease at times.

X-Q. 95. Your last answer is a little indefinite; I wish you would nudge your memory a little, and tell me what month, or about what month, of 1872 it was, that your son Charles was born?

A. He was born June the 5th, as near as I can recollect now; I am of very poor memory, that I am; I remembered the year correctly, but had just forgotten the month.

X-Q. 96. When last, before you came into the room this morning, to give your testimony, had you seen any of your husband's talking machines, or what you understood to be such?

A. I haven't seen any for two years.

X-Q. 97. Have you been in attendance at the office of defendant's counsel, Mr. Jacobs, within the past month at any time before this morning?

A. No, sir.

X-Q. 98. You mean to say, do you, that at no time within the past month, until this morning, were you in the office of Mr. Jacobs, or in this building?

A. No, sir; I was never in this building before this morning.

X-Q. 99. When last, before this morning, did you visit Harrisburg?

A. It may have been a week, or a week and a half, or it might be two weeks.

X-Q. 100. What was your business in Harrisburg on that occasion, and whom did you meet and talk with?

A. I came over on purpose to see Mr. Hill, and met him and spoke to him.

X-Q. 101. Where was that?

A. It was in the Franklin House, up stairs in the parlor.

X-Q. 102. You say this may have been a week, or may have been two weeks ago; is that the best statement of time which your memory will allow you to give?

A. It is the best I could give you just now, without making a mistake.

Mr. Hill states for the information of Mr. Howson, that this interview with Mrs. Drawbaugh, about which she has just been questioned, took place just before Mr. Howson was summoned away from Harrisburg on account of the sudden illness of his father February 11, 1885—and that, had it not been for the unavoidable suspension of proceedings at that time, this witness would have been examined within a day or two thereafter.

X-Q. 103. In your answer to interrogatory 36, you say that Mr. Drawbaugh was in the habit of working at night in his shop every night; you make that statement, do you, of the whole period from 1869 or 1870, down to 1880?

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A. Yes, sir; and ever since I know him, including Sundays even.

X-Q. 104. That has been his constant habit then, ever since you and he were married?

A. Yes, sir; and before.

X-Q. 105. How far from the bed was the stove-pipe hole, which you have mentioned in your direct examination?

A. Very close.

X-Q. 106. Behind the bed or how?

A. It was in the center of the room; I didn't keep the bed always in one place; I didn't have any behind the bed in my room.

X-Q. 107. What I wish to know is, where that stove-pipe hole was with reference to the bed, at the time you have been speaking of?

A. It had always been in the floor, if I understand you right.

X-Q. 108. Please hear the question again, and see if you can't give me a better answer?

Question re-read to witness.

A. Well, we used the stove pipe coming up through the hole in winter time, and in summer time, when the pipe wasn't there, the hole was there. It was in the center of the room, I cannot give you a better answer than that. If you go over now you can see the hole for yourself; it is there yet. I didn't always use that room for my sleeping room. I slept in the front part of the house in the summer, and used that as the children's room,

X-Q. 109. Was the stove pipe hole at the head, or the foot, or at one side of the bed, at the time; that is what I want to know?

A. It was very near the head of the bed. I shifted my bed around; I didn't have it there all the time.

X-Q. 110. You say that it was very near the head of the bed; was it also to one side of the bed?

A. Yes, sir; very near the head of the bed.

X-Q. 111. You have referred to another room which you

occupied sometimes; what apartment of the house was below that room?

A. It was a room that we didn't just occupy all the time.

X-Q. 112. Was it a sort of parlor or sitting-room; or what was it used for, when you did use it at all?

A. We just had it for a room for him, when he would get company.

X-Q. 113. I suppose, by "him", you mean your husband?

A. Yes, sir.

X-Q. 114. From what sort of a stove was it that the pipe run, which came through the stove pipe hole you have mentioned, when there was a stove pipe there?

A. A self feeder, or "Morning Glory" stove.

X-Q. 115. Was there any other stove in the same room?

A. Sometimes I had a cooking stove in it.

X-Q. 116. Where did the pipe from that run to, when you had it in there?

A. Sometimes in the spring of the year I took the cooking stove to the wash house; then I didn't have any pipe at all. I didn't have the stoves in the room both at once. I would run the pipe up above into the chimney, or down below into the chimney just as I felt like.

X-Q. 117. As I understand you, this kitchen and eating-room in which you had a "Morning Glory" stove, and the sleeping room above it, were in the rear part of the house?

A. We generally called it the back part of the house.

X-Q. 118. In what year was it that you left that house?

A. I can't give you the exact year.

X-Q. 119. Where did you move to from there?

A. We moved to Mechanicsburg.

X-Q. 120. In what year did you move back again from Mechanicsburg to Eberly's Mills?

A. I cannot tell you the year; we lived but one year in Mechanicsburg.

X-Q. 121. How many children have been born to you since the boy Charles?

A. One.

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Re-direct by Mr. Hill:

Q. 122. What is the name of your youngest child, and how old is she?

A. Maud; she is going on nine years old.

Q. 123. Was she born in Milltown or at Mechanicsburg?

A. At Milltown.

her
ELCINDA JANE X DRAWBAUGH.
mark

Affirmed and subscribed to before me this 11th day of March, 1885; the witness making her mark because her right hand was sore and bandaged up.

FRED. M. OTT,
Special Examiner.

Mrs. Elcinda Jane Drawbaugh re-called.

Examined by Mr. Hill:

Q. 1. Was Maud born before you moved to Mechanicsburg, or after you moved back to Milltown?

A. Before we moved to Mechanicsburg.

Q. 2. How old was she when you moved to Mechanicsburg?

A. She was in the neighborhood of four or five months old.

Q. 3. Do you remember in what month her birthday comes?

A. In October.

her
ELCINDA JANE X DRAWBAUGH.
mark

Subscribed to before me this 11th day of March, 1885, the witness having previously been affirmed.

FRED. M. OTT,
Special Examiner.

DEPOSITION OF WILSON H. STRICKLER.

March 12, 1885.

Examination resumed.

Present: Same counsel.

Wilson H. Strickler being produced, sworn and examined, saith:

Examined by Mr. Hill:

I formerly signed my name Wilson Strickler; that used to be my name; but on being baptised I took the name of Wilson H. Strickler; I reside in Ford county, Kansas; I am a stock raiser; I am about forty-two years of age.

Q. 1. When did you arrive in Pennsylvania on this trip to Harrisburg?

A. On this Thursday morning, the 12th day of March, 1885.

Q. 2. When were you last in Pennsylvania before this trip?

A. About the latter part of February, 1878.

Q. 3. Did you formerly live in Pennsylvania; if so, at what place?

A. I did, at Harrisburg, Penna.; I also lived at Lebanon, Penna., and Lancaster City, Penna.

Q. 4. Were you ever at Milltown, Cumberland county, Penna.?

A. I was there once.

Q. 5. Never there but once?

A. Never there but once.

Q. 6. Did you ever make the acquaintance of Daniel Drawbaugh, of Milltown?

A. I did.

Q. 7. Where did you first make his acquaintance?

A. At Milltown, Penna.

Q. 8. Where did you see him last, to know him?

A. At Milltown, Penna.

Q. 9. Have you never seen him since the day when you made his acquaintance there at Milltown?

A. I have not.

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Q. 10. Have you seen him since you arrived here this morning?

A. I have not.

Q. 11. In what year was it that you visited Milltown, on that one occasion, and made the acquaintance of Daniel Drawbaugh there?

A. In 1874.

Q. 12. In what season of the year was it?

A. In the summer.

Q. 13. Will you state how you happened to go to Milltown that day—what caused you to go there?

A. I visited a friend living near Milltown, and told him of a process I was preparing to insulate telegraph wires with mica; and also, that I was desirous of ascertaining how insulated telegraph wire was ordinarily covered with webbing, so as to know whether the ordinary process of covering with webbing would be a suitable means to enable me to insulate with mica; my friend told me, he would take me to see Mr. Drawbaugh, at Milltown, who was then covering telegraph wire with webbing.

Q. 14. And you went to see Mr. Drawbaugh, I suppose, did you, in consequence of what your friend told you?

A. We went to see Mr. Drawbaugh, accordingly.

Q. 15. Do you remember what day of the week it was that you went to see Mr. Drawbaugh?

A. It was on a Sunday morning.

Q. 16. Did you patent your process of insulating telegraph wire?

A. I did.

Q. 17. Have you any paper here with you, showing the date and number of that patent of yours?

A. I have.

Q. 18. Will you please produce it, and show it to the examiner, in order that he may take from it the date and number of the patent?

A. I will.

Witness produces a paper purporting to be an assignment of a one-sixth interest in said patent,

which patent is stated in the assignment to be dated April 20th, A. D. 1875, and numbered 162,204. The assignment bears on its back the stamp of the United States Patent Office in blue ink, dated July 20th, 1875. The paper also has attached to it the official patent office certificate of record, in the following words and figures, to wit: "Received for record July 20th, 1875, and recorded in liber K 19, page 175, of transfers of patents.

In testimony whereof, I have caused the seal of the patent office to be hereunto affixed.

ELLIS SPEAR,
Acting Commissioner.

Ex. C. M.

Objected to as not evidence.

Respondents' counsel also produces a printed volume, certified by J. M. Thatcher, commissioner, under the seal of the United States Patent Office, to be true copies of the specifications and drawings of letters patent issued by the United States Patent Office during the month of April, 1875, and referring to pages 568 and 569 thereof, on which are printed the specifications of Wilson Strickler's patent, No. 162,204, asks the examiner to copy on to the record the printed heading of said specification. The examiner copies said heading, as follows:

"162,204, Insulated Telegraph Wires, Wilson Strickler, Lebanon, Pa. (filed August 22, 1874)."

And respondents' counsel further states that at the hearing he will, if necessary, and if required thereto by complainants' counsel, on sufficient notice, produce a certified copy of said patent and specifications.

Q. 19. Is this the patent to which you refer as granted to you for your invention?

A. It is.

Q. 20. Was your visit to Mr. Drawbaugh at Millt wn, before or after you filed your application in the pa ent office for your said patent?

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A. It was before.

Q. 21. When you visited Mr. Drawbaugh at Milltown that day, where did you find him?

A. We found him at his workshop.

Q. 22. Who was the friend who recommended you to go to see Mr. Drawbaugh on that occasion?

A. Mr. George Free.

Q. 23. When you went to Milltown to see Mr. Drawbaugh, did anybody go with you; if so, who?

A. Mr. George Free.

Q. 24. Did you get any information that day from Mr. Drawbaugh in regard to the mode practised by him of insulating wire by wrapping it with insulating material?

A. I did; I saw him insulate his wire with webbing.

Q. 25. Did he have a machine for that purpose, or do it by hand?

A. He had several machines there for covering the wire.

Q. 26. What else did you see there that day besides the insulating machine, if anything?

A. Mr. Drawbaugh called my attention to an arrangement which he called a talking machine.

Q. 27. Did he do anything besides calling your attention to this machine; if so, what?

A. He showed me how it operated, or endeavored to do so.

Q. 28. State anything else that was done?

A. He requested me to go to one end of a wire, which he had in his building; and he went to the other end, and articulated to me through a mouth-piece or something of that kind, similar to a can. He asked me if I heard him, and whether I understood him; I answered that I did. Some other conversation followed in reference to this apparatus, but which I do not remember.

Q. 29. You have stated that he endeavored to explain the apparatus to you; did he, in that explanation, inform you how the machine operated; and if so, will you state the conversation on that point so far as you remember it?

A. He gave me an idea. I asked him what agent he employed for transmitting the sound. He answered me,

electricity. I asked him how he generated it. He answered, that in this instance he was using magnetism, and showed me a large horse shoe magnet, which he was then using.

Q. 30. Was the magnet on the machine, or off the machine?

Objected to as as a leading and improper form of inquiry.

A. It was attached to the apparatus.

Q. 31. You have stated that Mr. Drawbaugh articulated through the apparatus, and asked you if you heard him, and whether you understood him; to which you replied that you did. How was this conversation carried on between you and Mr. Drawbaugh.

A. Apparently through the wire, he standing at one end and I at the other end.

Q. 32. Then, if I understand you, you not only heard him through the wire, but you answered back through the wire; am I correct in that?

Objected to as leading.

A. You are correct.

Q. 33. While this conversation was going on through the wire, was Drawbaugh in your presence, or out of sight?

Objected to as a leading and improper form of inquiry.

A. He was in another room, with a doorway intervening.

Q. 34. Referring to the instrument which he showed to you, having the large magnet to which he called your attention when explaining the operation of the machine, was that instrument at your end of the wire, or at his?

A. At his end.

Q. 35. Did you have an instrument at your end of the wire?

A. There was an apparatus of some kind, but its particular form I don't remember.

Q. 36. Referring again to the instrument which Mr. Drawbaugh had at his end of the wire, containing the large magnet, can you mention anything else that you remember being on the instrument, besides the large magnet?

A. Yes; there were two spools which were coiled with fine insulated wire.

Q. 37. Do you remember how the large magnet and the two spools were arranged with reference to each other?

A. They were at the two ends of the magnet.

Q. 38. What was the form of the large magnet?

A. It was similar in shape to a horse shoe.

Q. 39. Did Mr. Drawbaugh take you to the other end of the wire to show you this instrument with the large magnet upon it, or did he bring the instrument to you?

A. He brought the instrument to me.

Q. 40. Will you please go with the examiner to his room, and look at the exhibits there in his charge, and see if you find any instrument among them which looks like the instrument that Mr. Drawbaugh showed you there that day, having the large horse shoe magnet and the two spools upon it; and if you find such instrument, bring it up here to this room with you?

(Witness goes with the examiner and is shown the trunk of exhibits used in case of American Bell Telephone Company vs. People's Telephone Company in U. S. Circuit Court for the Southern District of New York, and selects instrument known as "C reproduced," and returns with it).

Q. 41. How closely does this instrument "C reproduced" resemble the instrument which Mr. Drawbaugh showed you at his shop, so far as you remember?

A. I should say, very closely.

Q. 42. Do you see any difference between the two instruments, so far as you can remember?

A. Not particularly.

Cross-examined by Mr. Howson:

Witness desires to make a correction and says: If I may be allowed to make a correction, I would say mule-shoe instead of horse-shoe; the mule-shoe is longer in the bar.

X-Q. 43. When was it that you were living in Lancaster, Penna.

A. I lived there on several different occasions.

X-Q. 44. When last.

A. After the close of the war of the rebellion.

X-Q. 45. Whereabouts in Pennsylvania were you in the latter part of February, 1878?

A. At Lebanon, Penna. and Harrisburg, Penna.

X-Q. 46. With whom, if any one, did you travel from your home in the West to Harrisburg, to testify in this case?

A. With Mr. George Free, of Pennsylvania.

X-Q. 47. He came out to Kansas to bring you here, did he?

A. He did.

X-Q. 48. I suppose he is the same Mr. George Free to whom you have referred in your direct examination?

A. He is.

X-Q. 49. You mention him as a friend of yours; is there any relationship or family connection between you?

Objected to as immaterial.

A. I am married to his wife's first cousin.

X-Q. 50. Is there any relationship or family connection between you and Mr. George Drawbaugh.

Same objection.

A. None whatever.

X-Q. 51. In the recent suit of the American Bell Telephone Company vs. the People's Telephone Company, a Mr. George Free testified on behalf of the defendants, and described himself as forty-one years of age; residing at White Hill, Cumberland county, and a dealer in cattle, &c.; is that the Mr. George Free you have reference to? (See page 505, defendant's proofs).

A. I presume it is the same person, as the one I have reference to resided at White Hill, Cumberland county, Penna.

X-Q. 52. What business was this Mr. Free engaged in at the time you paid him the visit in 1874, as you have stated?

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A. I have not sufficient information to answer that question.

Recess until 2 P. M.

X-Q. 53. When was it that you left the East to take up your residence in the West?

A. On or about the last day of February, 1878.

X-Q. 54. Where were you living immediately before you went West?

A. Alternately in Lebanon, Penna., and Harrisburg, Penna., but principally in Lebanon, Penna.

X-Q. 55. How long had you thus been alternating between the two places?

A. For several years.

X-Q. 56. Your business during that time was what?

A. Agent for the Society for the Prevention of Cruelty to Animals, located at Harrisburg Stock Yards; also, Yard Master at the Harrisburg Stock Yards for a certain period.

X-Q. 57. During what period were you acting as Yard Master at the Harrisburg Stock Yards?

A. I cannot answer that.

X-Q. 58. Can you tell me how long it was, then?

A. For a period of several months, in each separate capacity; I was also superintendent of the Harrisburg Fertilizer Company for several years previous—located at Perdix, Perry county, Penna.

X-Q. 59. You have referred to seeing at Mr. Drawbaugh's shop, several machines for wrapping wire; how many such machines did you see there at the time of your visit?

A. I only paid one visit, and then I saw several—two, or perhaps three.

X-Q. 60. Of the same, or different kinds and sizes?

A. To the best of my recollection, they braided different sizes of wire, and were braiding at that time.

X-Q. 61. Who, if any one, appeared to be superintending their running at the time?

A. Daniel Drawbaugh.

X-Q. 62. How long were you at Mr. Free's house on the

visit when, as you say, you went with him to Mr. Drawbaugh's shop?

A. The latter half of Saturday afternoon and all day Sunday.

X-Q. 63. I notice in the assignment, which you produced this morning, and which is referred to in connection with your answer to interrogatory 18, that there is reference to a company styled "The World Underground Mica Telegraph Wire and Ocean Cable Manufacturing Company"; was there an actual corporation of that style; and if yes, who were the persons interested in it?

A. Yes, sir, there was; the persons interested in it were: Robert Brown, telegraph contractor, of New York city, secretary and treasurer; Hon. Jack G. Heilman, of Lebanon county, Penna., president; myself and other stockholders; it was organized under the laws of the State of New York, with office on Broadway.

X-Q. 64. Organized to work this patent of yours?

A. Yes, sir; for that express purpose, and no other.

X-Q. 65. Was any manufacturing done by the company under your patent?

A. Some to my knowledge; but I was kept in ignorance as to the full workings of the company, by the officers thereof; the manufacture, to my knowledge, was used by several New York companies.

X-Q. 66. The company to work your patent was organized before the patent had been obtained; was it?

A. Not to my knowledge; I do not think it was.

X-Q. 67. How long after, then, according to your recollection?

A. The application for the charter was executed and signed by the incorporators, and forwarded to the proper office, immediately upon the receipt of the patent, at the earnest solicitation of Mr. Brown.

X-Q. 68. Were there other Pennsylvania stockholders in the concern, besides those you have named; and if yes, will you be kind enough to name them?

This line of cross-examination objected to as

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entirely immaterial, the paper having been used in the examination in chief merely to show the number and date of the patent.

A. There were; I will name as many of them as I can; Mrs. A. R. Strickler, of Lebanon, Penna.; Harry Borgner, of Lebanon, Penna.; Dr. Elias Zerbey, of Lebanon, Penna. That is about all that I remember.

X-Q. 69. Down to what time did you continue to take an active interest in the concerns of that company.

A. To immediately prior to my departure for the West, which was in 1878.

X-Q. 70. Down to that time, what steps did you take, or what did you do, to further the interests of the company?

Same objection as to question 68.

A. Mr. Robert Brown, of New York, entered the company with the especial proviso that he would personally attend to that matter; and the same with relation to Jack C. Heilman. At the same time I done all in my power to further its interests.

X-Q. 71. Such as doing what, for example?

Same objection.

A. Soliciting patronage, and referring the same to R. Brown.

X-Q. 72. Have you taken out any other patents than the one referred to in your examination in chief?

A. I was about to enter an application for one, but did not do so.

X-Q. 73. About when was that?

A. Immediately prior to my going West.

X-Q. 74. For what class of invention?

A. For lessening retardation of transmission of the electric current in conductors and other purposes.

X-Q. 75. In conductors, such as telegraph wires, for example?

This line of cross-examination objected to as immaterial and as irrelevant, both to the examination in chief and the subject matter of the suit.

A. Yes, sir; ocean cables more particularly—conductors in general.

X-Q. 76. How long were you in Mr. Drawbaugh's shop on the occasion you have testified to?

A. Probably one hour, more or less.

X-Q. 77. What other things do you remember noticing in the place, beside the wire-wrapping machines and what has been called the talking machine?

A. Nothing in particular that I can remember.

X-Q. 78. I understand from your testimony that you had not seen the apparatus which you think was like exhibit "C reproduced", until Mr. Drawbaugh brought it out of the room in which it had been, into the room in which you were, and showed it to you; is that correct?

A. Yes, sir.

X-Q. 79. During the time this was going on, was anybody else in the place, that you remember, besides yourself and Messrs. Drawbaugh and Free?

A. No one else.

X-Q. 80. I understand that it was after the communications which passed through the wires, as you supposed, that Mr. Drawbaugh showed you the instrument which you think to have been like instrument "C reproduced"; is that correct.

A. Yes, sir.

Re-direct by Mr. Hill:

Q. 81. Was Mr. Drawbaugh wrapping wire when you went there that day, or did he merely operate the machine to show you what the process was?

Objected to as leading.

A. He was wrapping the wire when I first arrived at his place.

Q. 82. Mrs. George W. Drawbaugh and Mrs. George Free were examined as witnesses in the case of the American Bell Telephone Company vs. The People's Telephone Company, in November, 1881, and testified that they were sisters to each other; I understood you to testify this

1794

morning that Mrs. Free is a cousin to your wife, but that Mrs. Drawbaugh is not related or connected to you; how is that?

A. That is an error, so far as the understanding is concerned; if Mrs. George Drawbaugh and Mrs. Free are sisters, and one is a cousin to my wife, the other must be also; to the best of my knowledge they are full sisters.

Q. 83. Then when you answered cross-question 50, which the examiner will now read to you, do you remember what your understanding of the question was, or why you answered it as you did?

A. I do; I answered it in that way, because I do not consider Mr. George Drawbaugh any more related to me than I consider Mr. George Free, whom I consider no relation to me, as I do not consider the fact that the wife of either of those two gentlemen being first cousins to my wife could make each of the aforesaid gentlemen any relation to me; this is my construction of it.

Q. 84. How well are you acquainted with Mr. George W. Drawbaugh or his wife?

A. I met both of them but once.

Q. 85. How long have you been married?

A. Seventeen years, or since April, 1868.

W. H. STRICKLER.

Sworn and subscribed to before me this 12th day of March, 1885.

FRED. M. OTT,
Special Examiner.

Mr. Hill offers in evidence as "Exhibit Blake Preliminary Statement", a copy, certified by the acting commissioner of patents from the files of the patent office, of the sworn preliminary statement filed by Francis Blake, Jr., September 29, 1879, in the matter of the interference Blake vs. Edison, vs. Chinnock, vs. Phelps, for improvement in telephone; the same being the preliminary statement of Francis Blake in the interference to determine priority of invention between said parties as to the so-called Blake transmitter.

Objected to as immaterial and incompetent.

Mr. Hill also offers in evidence a similarly certified copy from the records of the patent office, of the letters patent granted to Francis Blake, November 29, 1881, No. 250,126, for improvement in speaking telephones, to be marked "Exhibit Blake Transmitter Patent"; the same being a copy of Mr. Blake's patent on the so-called Blake transmitter.

Same objection.

Also a copy certified by the commissioner of patents from the records of the patent office of the letters patent granted to Elisha Gray, July 27, 1875, No. 166,095 for improvement in electric telegraphs for transmitting musical tones; the same to be marked "Exhibit Elisha Gray Patent."

Same objection.

Also, from the same records and similarly certified, a copy of the letters patent granted to Edison and Harrington, August 12, 1873, No. 141,777, for improvement in relay magnets; the same to be marked "Exhibit Edison and Harington Patent."

Same objection.

Also, from the same records and similarly certified, copies of letters patent granted to Daniel Drawbaugh or his assignee, as follows, to wit:

October 31, 1882, No. 266,615, for improvement in telephone transmitters.

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February 27, 1883, No. 272,365, for improvement in telephone transmitters.

February 27, 1883, No. 272,866, for improvement in speaking trumpets for receiving telephones.

April 17, 1883, No. 276,186, for improvement in electric signalling apparatus for telephone lines.

April 17, 1883, No. 276,137, for improvement in telephone transmitters.

October 23, 1883, No. 287,111, for improvement in telephone repeaters.

December 25, 1883, No. 290,978, for improvement in telephones.

December 25, 1883, No. 290,979, for improvement in telephones.

December 25, 1883, No. 290,980, for improvement in telephone transmitters.

January 1, 1884, No. 291,311, for improvement in telephone transmitters.

January 1, 1884, No. 291,312, for improvement in telephone transmitters.

January 1, 1884, No. 291,472, for improvement in telephone transmitters.

February 5, 1884, No. 293,154, for improvement in telephones.

March 25, 1884, No. 294,741, for improvement in telephone transmitters.

March 25, 1884, No. 295,742, for improvement in telephone transmitters.

April 29, 1884, No. 297,578, for improvement in telephone transmitters.

April 29, 1884, No. 297,579, for improvement in telephone transmitters.

May 13, 1884, No. 298,676, for improvement in telephone transmitters.

August 19, 1884, No. 303,627, for improvement in telephone transmitters.

August 19, 1884, No. 303,628, for improvement in telephone transmitters.

August 19, 1884, No. 303,629, for improvement in telephones.

October 21, 1884, No. 307,026, for improvement in telephone transmitters.

The same to be marked, "Exhibit Drawbaugh Patents", No. 1 to No. 22, respectively.

Same objection to each of said patents.

Also, a copy of the original opinion filed by Judge Wallace in the case of the American Bell Telephone Company and others, against The People's Tolephone Company and athers, in the United States Circuit Court for the Southern District of New York, certified by Timothy Griffith, clerk of said court; the same to be marked, "Exhibit Judge Wallace, original opinion". As said opinion is not dated, Mr. Hill states that it was filled in the office of the clerk of the court, on December 1st, 1884, and that this copy was made on December 1st and 2nd, and certified to on December 3rd, 1884.

Same objection.

March 14, 1885.

Mr. Hill now states that the taking of testimony in these cases, so far as he himself is concerned, is closed.

Philadelphia, March 14, 1885.

I hereby certify, that the foregoing depositions of witnesses, on behalf of respondents, were taken before me at the times and places set forth in the foregoing record, and that the witnesses severally were sworn or affirmed by me and signed their depositions in my presence; also, that the various exhibits and papers put in evidence were left in my custody at the times set forth in said record.

FRED. M. OTT,
Special Examiner.

IN THE CIRCUIT COURT OF THE UNITED STATES.

FOR THE SOUTHERN DISTRICT OF NEW YORK.

AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, ET AL.	In Equity.

IN THE CIRCUIT COURT OF THE UNITED STATES,

FOR THE DISTRICT OF NEW JERSEY.

AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, ET AL.	In Equity.

IN THE CIRCUIT COURT OF THE UNITED STATES,

FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, THE PENN OVERLAND COMPANY, ET AL.	In Equity.

Philadelphia, February 6th, 1885.

Report of a meeting held at the Washington Hotel, on Chestnut Street above Seventh, in the city of Philadelphia,

1799

this afternoon, February 6th, 1885, at 2:45 o'clock, for the purpose of testing certain instruments on the part of the respondents.

Present:—Mr. Storrow,
Mr. Dickerson,
Counsel for Complainants.
Judge Hill,
Mr. Jacobs,
Counsel for Respondents.
Mr. Ott,
Examiner.
Professor Barker,
Professor Cross,
Professor Wright,
Mr. Drawbaugh,
Mr. Pope,
Mr. Heiges,
Mr. Marks,
Mr. Ernest Marks, and others.

Report of J. L. Kendelhart, stenographer for the defendants, stationed in Room No. 29.

Mr. Storrow: Complainants' counsel requests defendants' counsel to open the instruments of the F form, which he says he expects to try here, and also the instrument of the C form, which he says he expects to try here.

Judge Hill: Respondents' counsel replies that he shall not allow any of the instruments to be taken apart, nor tampered with in any way until after the tests have been made with them, after which all the instruments tested will be placed in the hands of the examiner, and may be inspected and examined by complainants' counsel at their own will in the presence of the examiner.

Mr. Storrow: Complainants' counsel says that he has not asked that he be allowed to take them apart, nor has not suggested that they be tampered with. His request is that the

1800

denfendants' counsel or his expert take them apart in the presence of complainants' counsel, that they may see their construction.

JUDGE HILL: Respondents' counsel says that it is now almost three o'clock, a delay having occurred from half-past twelve until the present time by reason of the accidental detention of Prof. Barker at the University of Pennsylvania, and respondents' counsel has been informed by complainants' counsel that complainants' experts are obliged to leave by the half-past six train; there is therefore no time to unnecessarily spend at this stage, and respondents are ready now to proceed with the tests. After the tests have been made the instruments will be taken charge of here by the examiner, and if the purpose of complainants' counsel is merely to know all about the construction of the instruments, that purpose can be served just as well by an examination after the tests as before; and it is not reasonable to ask us to delay the tests any further. We are now ready to proceed, and we ask the complainants' experts and counsel to take their stations in the transmitting and receiving rooms, as they may think best, and to proceed immediately with the tests.

MR. DICKERSON: Complainants' counsel repeat the request that they have made, with thanks for the care that defendants' counsel seem to take of the defendants' witnesses.

JUDGE HILL: Respondents' counsel do not propose to waste any more time in this matter, and are now ready to go on with the tests. I ask complainants' counsel whether they propose to go on or not.

MR. DICKERSON: Complainants' counsel are here under notice and are ready to witness anything that takes place.

JUDGE HILL: Very well; we are ready to proceed with the tests.

Mr. Jacobs, will you step over to Prof. Barker's room and tell him?

Mr. Drawbaugh, will you adjust and attach those instruments?

1801
1761

MR. HILL: The first test will be made with an instrument of the F form, having the carbon box supported by the single stem or rod as the transmitter on the test line, which instrument is marked F 2; the line is a metallic circuit extending from room 29 to room 28, in the Washington Hotel, Philadelphia, the arrangement of the lines being the same as described by Prof. Barker in his deposition. There is a battery in the line consisting of two Leclance cells. The receiving instrument in room 28 is of the form known as B. Besides this test line there is a metallic circuit, which will be used as a tell-tale line, it being equipped with two Tisdel magneto instruments, one at each end of the line.

MR. DICKERSON: Counsel for complainants objects to the use of a tell-tale line in aid of the instrument, it not being probable that Drawbaugh had a Tisdel telephone line when he performed the experiments he testifies to, unless it is proved that he had.

JUDGE HILL: Respondents' counsel replies that the tell-tale line is used for convenience and to save time, and is the same as was used in New York, about the 1st of April, 1882.

MR. DICKERSON: Complainants' counsel observes that the arrangement of the situation of the room is, as testified to by Prof. Barker, such that the operator at the transmitter and the operator at the receiver are in sight of each other. He therefore requests that the window shades of one or both windows be drawn down.

JUDGE HILL: Respondents' counsel replies that if the window shades can have the slightest effect upon the tests in any conceivable way they shall be drawn down as requested, and he directs Mr. Heiges to shut the window and draw down the shades.

(Mr. Heiges sits down by the side of Mr. Hill.)

(Mr. Drawbaugh takes a seat at the transmitter.)

MR. HEIGES: Are you ready?

MR. DRAWBAUGH: I will have to adjust it first.

MR. HEIGES: All right.

1802

MR. DRAWBAUGH: (Speaking through the instrument.) Now Professor, I am speaking in the tumbler instrument. I wish to adjust it.

MR. HEIGES: (At the tell-tale.) All right.

MR. DRAWBAUGH: I am now speaking in the single-stem tumbler instrument F; is the adjustment right?

MR. HEIGES: (At the tell-tale.) Do you hear anything?

DR. DICKERSON: Counsel for complainants now objects after it appears that nothing can he heard through the F 2, to have the tell-tale line used as the means for setting up an adjustment that could not otherwise be gotten; it not being probable that at the trials at Eberly's Mills there was a talking telephone alongside the figure F, by means of which an adjustment that could talk could be procured.

JUDGE HILL: Respondents' counsel objects to the interruptions and delays interposed by complainants' counsel.

MR. HEIGES: (At the tell-tale.) Ready now. Are you ready? Mr. Marks, are you ready to listen? Listen now, there will be some talking done.

MR. HEIGES: (At the tell-tale.) Adjust and go ahead.

MR. DRAWBAUGH: Well, how is it now? Do you hear me now? One, two, three, four. (To the counsel.) I can't see where it is. I can't see where the adjustment is. (To the instrument.) One, two, three, four. Do you hear me now? Professor, do you hear me now? Can you hear anything now? Do you hear me now?

MR. HEIGES: (At the tell-tale.) Is Professor Barker at the instrument now? Ready? Are you ready now?

(Mr. Drawbaugh speaking through the instrument.)	(Mr. Heiges, repeating from the tell-tale.)
Professor, do you hear me now? Is the adjustment right?	Professor, do you hear me now. Is the adjustment right?
	Now ready.
Now I will count for you.	(Speaking into the tell-tale.) Do you want it changed? Isn't it loud and distinct? How do you want it? It isn't loud.

1803

Well, now, how is it now?	(Speaking into the tell-tale.) Can you tell any change? Do you hear anything?
Well, now I will speak again. Is the instrument right?	It is not as good as before.
Now I will change it a little. How is it now?	A little better.
Now I will count for you.	He says it is a little better. You shall talk now.
One, two, three, four, five, six.	One, two, three, four, five, six.
We are in room 29, Washington Hotel.	He says it is too loose.
I have changed the adjustment. How is it now Professor?	It is better.
Now I have still changed again. How is it now?	Becoming better all the time.
Now I have changed it again. Is it better now?	Now I have changed it again. Is it better now? It is very good now.
We are now in room 29, Washington Hotel.	We are now in room 29, Washington Hotel.
I think now I will let Judge Hill take the instrument.	Please repeat.
Well, I hardly know what to say.	Well, I hardly know what to say.
Shall I count again?	Are you ready? They are ready.
There are a number of insulated wires hanging against the wall.	There are a number of insulated wires against the wall.
There are three beds in this room.	There are three beds in this room.
There is also two short-hand writers in the room.	Repeat.
There are also two short-hand writers in this room.	There are two short-hand writers in this room.
Mr. Dickerson has just sat down.	Mr. Dickerson has just sat down.
Mr. Jacobs is walking the floor of this room.	Mr. Jacobs is walking on the floor of this room.
Mr. Ernest Marks is standing near the door.	Mr. Ernest Marks is standing near the door.
Mr. Pope is sitting on the lounge.	Repeat that.
Mr. Pope is sitting on the lounge.	Mr. Pope is sitting on the lounge.
There is a table before me which I am resting upon.	Repeat, not quite so loud.

1804

EVIDENCE FOR DEFENDANTS.

There is a table before me which I am resting upon.

There is a telephone cord laying on this table.

Telephone cord.

It is a very pleasant day.

Washington is 140 miles from Philadelphia.

The Atlantic Ocean is 3000 miles wide.

Boston is the capital of Massachusetts.

Now I think I will allow Mr. Hill to take the transmitter.

(Mr. Hill speaking through the instrument.)

Professor Barker, do you hear me now?

Do you distinguish the difference between my voice and that of Mr. Drawbaugh?

(The trouble was on the tell-tale line.)

How is the articulation of this instrument now?

How plainly can you hear what I say?

When did you leave the University to-day?

Did you deliver a lecture before you left?

How many students had you present at your lecture?

What was the subject of the lecutre?

There is a table before me which I am resting upon.

There is a telephone coach—

Telephone cord.

It is a very pleasant day.

Washington is 140 miles from Philadelphia.

The Atlantic Ocean is 3000 miles wide.

Boston is the capital of Massachusetts.

Now I think I will allow Mr. Hill to take the transmitter.

(Mr. Heiges repeating from the tell-tale.)

Are you ready?

Professor Barker, do you hear me now?

Do you distinguish—(I cannot repeat that; please give me that again, Mr. Marks.) Do you distinguish the difference between my voice and that of Mr. Drawbaugh's? Yes, sir.

How is the articulation of this instrument now? Very good.

How plainly can you hear what I say? Perfectly.

When did you leave the University to-day? Quarter to two.

Did you deliver a lecture before you left. Yes.

How many students had you present at your lecture? Between eighty and ninety.

What was the subject of the lecture?

(Repeat the subject. Repeat what the subject was. I missed it. I do not get you yet.

1805

I have not got it yet. You get a little too close when you talk. Please repeat again. I get all except what the lecture was on; that I do not get. I do not get what the lecture was on. You speak too quick. Give me time to get the receiver to my ear, will you please. Now give me what the lecture was on. Yes, sir. Hello.)

(THE REPORTER: Mr. Marks enters the room at this point and says that Professor Barker says the subject of his lecture was Polarization.) (This trouble was on the tell-tale.)

Now, Professor, do you hear me?

Your lecture was on Polarization, was it?

I should like to have been present and heard it.

Was it on the polarization of light?

Will you tell me who discovered the polarization of light and its cause?

This case will be tried before Judge McKennan and Judge Butler.

Mr. Drawbaugh is now sitting near the bed in this room.

Did you illustrate your lecture by any experiments on the polarization of light?

Chestnut street is one of the finest streets in Philadelphia.

Does this instrument still hold its adjustment well?

Mr. Storrow is in your room, is he not?

Professor Cross is with him, is he not?

And there is a stenographer in the room on the part of the Bell Company, is there not?

(Are you ready. Wait a moment. All ready; go ahead.)

Now, Professor, do you hear me?

Your lecture was on Polarization, was it?

I should like to have been present and heard it.

Was it on the polarization of light?

Will you tell me who discovered polarization of light, and its cause?

This suit will be tried before Judge Kennan and Butler.

Mr. Drawbaugh is now sitting near the bed in this room.

Did you illustrate your lecture and experiment on the polarization of light?

Chestnut street is one of the finest streets in Philadelphia.

Does this instrument still hold its adjustment well?

Mr. Storrow is in your room, is he not?

Professor Cross is with him, is he not?

There is a stenographer in the room, is there not, on the part of the Bell Company?

It is said that General Gordon has either been captured or killed.

And that the position of the British army in Egypt is very precarious.

Professor Barker, suppose I read you something from a newspaper.

It is said that General Gordon has either been captured or killed.

And that the position of the British army in Egypt is very precarious.

Professor Barker, suppose I read you something from a newspaper. (Please give your answer to that question to me. Give me the answer to that question.)

(MR OTT: I suggest you mention the paper in each case.)

Are you ready now?

I read an article from the Philadelphia Press of this morning, February 6th.

Atlanta, Georgia, February 5.

Hon. Thomas A. Hendricks and party.

Reached Atlanta this morning at four o'clock.

In a special car.

At half-past eight.

They were escorted to the Kimball House.

Where breakfast was served.

Where breakfast was served.

Where breakfast was served.

The company they met at breakfast.

The company they met at breakfast.

The company they met at breakfast.

Consisted of about thirty prominent citizens.

A large crowd was congregated about the hotel.

The Mayor introduced Mr. Hendricks.

Who addressed the people from the balcony.

After the speaking.

Are you ready now?

I read an article from the Press of this morning, February 6th.

Atlanta, Georgia, February 5.

Hon. Thomas A. Hendricks and party.

Reached Atlanta this morning at four o'clock.

In a special car.

At half-past eight.

They were escorted to the Kimball House.

Repeat.

Again.

Where breakfast was served.

The company assembled at breakfast.

Repeat.

The company they met at breakfast.

Consisted of about thirty prominent citizens.

A large crowd was congregated about the hotel.

The Mayor introduced Mr. Hendricks.

Who addressed the people from the balcony.

After the speaking.

1807

The ladies were driven around the city.

And the gentlemen proceeded to the Hall of the House of Representatives.

Where a reception was held.

And several hundred persons.

Where presented to the Vice-President elect.

The party left for Birmingham.

At ten o'clock.

And will proceed from there.

To the New Orleans Exposition.

Much enthusiasm.

Was manifested over Mr. Hendricks.

That is the end of the article.

What receiver have you now on the line at your end?

You say you have receiver B 2. Is that correct?

All right, I will now remove this instrument F 2.

No, I have changed my mind; I will not remove it.

But I will ask you to remove your receiver.

And to substitute one of the receivers of the form known as I.

When you have done it I will resume.

When you have done that I will resume.

Now, Professor Barker, do you hear me?

The ladies were driven around the city.

And the gentlemen proceeded to the Hall of the Representatives.

Where a reception was held.

And several hundred persons.

Were presented to the Vice-President elect.

The party left for Birmingham.

At ten o'clock.

And will proceed from there.

To the New Orleans Exposition.

Much enthusiasm.

Was manifested over Mr. Hendricks.

That is the end of the article.

What receiver have you now on the line at your end?

(What? Did you say E 2? I can't get you right. You get too close when you speak. I have it now, B 2. Well, the second letter of the alphabet and the second letter of the numeral.)

You say you have receiver B 2. Is that correct?

All right, I will now remove this instrument F 2.

No, I have changed my mind; I will not remove it.

But I will ask you to remove your receiver.

And substitute one of the receivers of the form known as I.

I was not listening. Please repeat.

If you have done that I will resume.

Are you making the change? All right. Hello. Yes, we are ready. Are you?

Now, Professor Barker, do you hear me?

Do you hear me any more plainly than you did with the receiver B 2?

Please answer back whether you do or not.

Suppose now I read you an article from the newspaper.

Are you ready? Please answer back.

I will read another article from this morning's Philadelphia Press.

It is entitled "Hearty endorsement of General Logan."

And is copied from the New York Independent.

It is as follows:

We sincerely desire the re-election.

To the United States Senate.

Of General John A. Logan, of Illinois.

He has been a very useful and true man.

Has done good service to his country.

As a soldier.

And is greatly respected in Congress.

He has the entire confidence.

Of the Republican Party.

And of the people generally.

Both in and out of the state.

He now so ably represents.

He now so ably represents.

No, not who, he. He now so ably represents.

And he doubtless will have as he deserves to have.

The solid vote.

Of all the Republicans.

Do you hear me any more plainly than with the receiver B 2?

Please answer back whether you do or do not. Yes, sir; I hear you just as distinctly and a little louder.

Suppose now I read you an article from the newspaper.

Are you ready? Please answer back. Yes.

(The Professor was not listening. Please repeat.)

I will read another article from this morning's Philadelphia Press.

It is entitled "Hearty endorsement of General Logan."

And is copied from the New York Independent.

It is as follows:

We sincerely desire the re-election.

To the United States Senate.

Of General John A. Logan, of Illinois.

He has been a very useful and true man.

Has done good service to his country.

As a soldier.

And is greatly respected in Congress.

He has the entire confidence.

Of the Republican Party.

And of the people generally.

Both in and out of the state.

Who now so ably represents.

Who now so ably represents.

No, not who, he. He now so ably represents.

And he doubtless will have, as he deserves to have.

The solid vote.

Of all the Republicans.

1809

Of the Legislature of Illinois.	Of the Legislature of Illinois.
To secure his return to the Senate.	To secure his return to the Senate.
That is the end of the article.	This is the end of the article.
And I cordially endorse what it says.	And I certainly endorse what is says.
Although Mr. Drawbaugh would probably take the opposite side.	My friend Mr. Drawbaugh, would probably take the opposite side.
Now, I will remove instrument F 2.	Now I will remove the instrument F 2.
And substitute another form of F instrument.	And substitute another form of F instrument.
Which has the carbon box supported by two rods or wires.	Which has the carbon box supported by two rods or wires.
The one I have been using.	The one I have been using.
Had the carbon box supported by a single rod.	Had the carbon box supported by a single rod.

Mr. Dickerson asks to look at the instrument.

Judge Hill removes the tumbler instrument marked F 2, and substitutes tumbler instrument marked F 1.

Hello, Hello.	Are you ready? Are you ready? Hello. Yes, sir; we are ready if you are. Are you ready? Yes, ready.
Hello. Prof. Barker, do you hear me?	Professor, do you hear me?
How is the adjustment?	How is the adjustment?
Please answer back how it is.	(Did not understand you.) The question was, how is that? The answer is, better.
I asked how is the adjustment?	I asked how is the adjustment. Answer. Not good.
Is it too loud or too weak?	Is it too loud or too weak? Answer. Loud.
I commenced to use it without adjusting it.	I commenced to use it without adjusting it.
I took it out of the box.	I took it out of the box.
And affixed it to the line.	And I fixed it to the line.
Just as it was.	Just as it was.
But I will now adjust it a little.	But I will now adjust it a little.

1810

If you think it will work better.

What do you think about it?

Well, how is it now?

I have changed it a little. How is it now?

Perhaps I speak a little too loud into it. How is it now?

I spoke too loud, I suppose.

Do you think you could hear a newspaper article now?

I will read you something again from this morning's Press.

Washington, February 5.

There were quite a number of absentees.

On the Democratic side.

On the Democratic side.

Of both the House and Senate Chambers.

This morning.

And the invariable answer was.

When a Senator or Representative could not be found.

Gone to see Cleveland.

Gone to see Cleveland.

Gone to see Cleveland.

Several of the gentlemen.

Who have been contemplating visits to the President elect.

Who have been contemplating visits to the President elect.

Who have been contemplating visits to the President elect.

Well, let us adjust it then a moment.

How is it now?

If you think it will work better.

What do you think about it? Answer. I think the articulation might be improved.

Well, how is it now? Answer. Very weak.

I have changed it a little; how is it now? Answer. Good as to loudness, but the articulation not so good.

Perhaps I speak a little too loud. How is it now? Answer. Better.

I spoke too loud, I suppose.

Do you think you could hear a newspaper article now? Answer. Yes.

I will read you something again from this morning's Press.

Washington, February 5.

There were quite a number of absentees.

Repeat.

On the Democratic side

Of both the House and Senate Chambers.

This morning.

And the invariable answer was.

When a Senator or Representative could not be found.

Repeat.

What do you say? Repeat again.

Gone to see Cleveland.

Several of the gentlemen.

Repeat.

Repeat a little louder.

No use, the adjustment is bad.

Very weak.

How is it now? Better, if you will talk lower.

1811

Now, how is it?	Now, how is it? Answer. Good but speak a little lower.
Very well; I will resume the newspaper article where I left off. Do you get that?	Now I will resume the newspaper article where I left off.
Are you ready?	(Hold on; he said something to me and I did not get it. What did you say? Answer. No; adjust a little closer.)
Well, how is it now? Do you get it any plainer?	How is it now? Do you get it any plainer? No; very weak.
Well, how is it now?	How is it now? Very good.
Shall I resume the newspaper article now?	Shall I resume the newspaper article now? Answer. Yes, but talk a little lower.
Several of the gentlemen.	Several of the gentlemen.
Who have been contemplating visits to the President elect.	Who have been contemplating visits to the President elect.
Upon the published notices that he would be home.	On the published notices that he would be home.
To all persons desiring to talk with him.	To all persons desiring to talk with him.
Regarding Governmental business.	Regarding Governmental business.
Were surprised to learn.	Were surprised to learn.
That special invitations.	That special invitations.
Had been extended.	Had been extended.
To a majority of the Senators.	To a majority of the Senators.
And quite a number of the more prominent Representatives.	And quite a number of the more prominent Representatives.
This fact, however.	This fact, however.
Is intended in no way.	Is intended in no way.
To preclude others from calling upon Cleveland.	To preclude others from calling upon Cleveland.
Those who have had invitations.	Those who have had invitations.
Understood that their visit.	Understood that their visit.
Is primarily to make the acquaintance of the President elect.	Was primarily to make the acquaintance of the President elect.
And discuss with him.	And to talk with him.
Discuss with him matters of legislative and executive policy.	And discuss with him matters of executive and legislative policy.

1812

Rather than to give advice.

As to the selection of a cabinet.

The more prominent visitors however.

Will not hesitate to give Mr. Cleveland.

Their views regarding cabinet appointments.

Their views regarding cabinet appointments.

And the friend of Mr. McDonald.

And the friends of Mr. McDonald.

Mr. Barbour.

Mr. Money.

Mr. Money.

Money. M-o-n-e-y.

M-o-n-e-y.

Mr. Money.

Mr. Stockton.

Stockton.

Stockton.

Stockton, S-t-o-c-k-t-o-n.

S-t-o-c-k-t-o-n.

O, not a.

Stockton, Mr. Stockton and others.

Will tell Mr. Cleveland.

Will tell Mr. Cleveland.

Why they think.

He should choose those gentlemen.

For posts at the executive board.

That is the end of the article.

How is the adjustment now?

I have not adjusted it since I commenced to read the article.

The second time.

And have held it in my hand all the time.

Rather than to give advice.

As to the selection of a cabinet.

The more prominent visitors however.

Will not hesitate to give Mr. Cleveland.

Reviews regarding cabinet appointments.

Their views regarding cabinet apments.

Repeat.

And the friends of Mr. McDonald.

Mr. Barbour.

Repeat.

Mr. Many.

M-a-n-e-y.

M-o-n-e-y.

Mr. Money.

Mr. Hopkins.

Repeat.

What do you say? Repeat again.

S t-a-c-k-t-o-n.

S-t-a-

O, not a.

Mr. Stockton and others.

Repeat.

Will tell Mr. Cleveland.

Why they think.

He should choose those gentlemen.

For posts at the executive board.

That is the end of the article.

How is the adjustment? Answer. Very good.

I have not adjusted since I commenced to read the article.

The second time.

I have held it in my hand all the time.

1813

What receiver have you now on your end of the line?	What receiver have you now on your end of the line. Answer. I I.
Now, will you please remove I I and substitute an instrument of the B form?	(I can't get you right. Come more plainly.)
	Now, will you remove I and substitute one of the B form.
Answer back please.	What do you say? Ready?
What receiver have you now on?	What receiver have you now on? B 2.
How is the articulation with these two instruments?	How is the articulation with this instrument?
With these two instruments?	The articulation is good, but it is weak.
I will adjust it a little different.	We will have it adjusted a little different.
How is it now?	How is it now? Answer. Much better.
Is it well enough adjusted now?	Is it well enough adjusted now?
Please answer back.	Please answer back. (What do you say? Please repeat that to me Mr. Marks, will you?) Answer. It is in fair adjustment now.
What time do you get your dinner generally?	Repeat.
What time do you generally get your dinner?	What time do you generally get to dinner?
It is now twenty-five minutes to five.	It is now twenty-five minutes of five.
I will talk to you a little to try the B receiver.	I will talk to you a little upon the B receiver.
In order to test that instrument.	In order to test that instrument.
How do you get the sound now?	How do you get the tones now? Answer. Pretty well.
This is a very pleasant day.	This is a very pleasant day.
Washington is 120 miles from Harrisburg.	Washington is 120 miles from Harrisburg.
I will count a few irregular numbers.	I will count a few irregular numbers.
1, 5, 10, 24.	1, 5, 10, 24.
29, 33, 37, 40.	29, 33, 37, 40.
45, 54, 68.	45, 57, 68.

74, 81, 93.	74, 81, 93.
114, 135, 160.	113, 125, 150.
113, 135, 160.	113, 125, 150
135.	135.
160.	150.
60.	60.
210.	210.
320.	330.
20.	20.
901.	Repeat, will you please. 401.
901.	901.
1876.	1876.
1885.	1885.
How does the adjustment of this instrument hold out?	How does the adjustment of this instrument hold out. Answer. Very good.
I have not changed it since I began to read the newspaper article the second time, if I remember right.	I have not change since I began to read the newpaper article the second time.
I will now resume this instrument and substitute an instrument of the C form.	I will now remove this instrument and put on an instrument of the C form.
Are you ready?	(Just wait a little and they will be ready soon. Hello. Put on instrument I at your end. What's that? Says it is hard work. The Professor is getting tired.) Ready now.
Hello. Do you hear me now?	Hello. Do you hear me now? Yes.
Well, how plainly do you hear me?	Well, how plainly do you hear me? Distinctly, but not very loud.
Are you getting tired of listening, Professor.	Are you getting tired of li tening, Professor Barker? Yes, I am getting —(the last word of that answer I lost. What? I don't get you. All right. go ahead.). (Trouble on the tell-tale line.)
Now, are you all ready again?	Now, are you all ready again? Answer. Yes.
Mr. Drawbaugh and Mr. Jacobs are both standing up.	Mr. Drawbaugh and Mr. Jacobs are both standing up.
Mr. Dickerson is examining the instrument F which we just used.	Mr. Dickerson is examining the instrument F.

1815

And has already taken it apart.	And has already taken it apart.
Mr. Pope and another gentleman are examining it with him.	Mr. Pope and another gentleman are examining it with him.
It is now ten minutes of five.	It is now ten minutes of five.
But I will put these tests through as rapidly as possible.	And I will put these tests through as rapidly as possible.
General Grant is said to be quite ill.	General Grant is said to be quite ill.
He is affected with a trouble of the throat.	He is afflcted with a trouble of the throat.
Caused by an excessive use of to bacco.	Caused by an excessive use of to-bacco.
And Mr. Drawbaugh.	And Mr. Drawbaugh.
As soon as he just heard me say this.	And Mr. Drawbaugh.
When he just heard me say this.	When he just heard me say this.
Threw his tobacco away.	Threw his tobacco away.
Mr. Ott, the examiner, is looking quite impatient.	Mr. Ott, the examiner, is looking—
Is looking quite impatient.	Quite impatient.
And he says that the reason of it is.	(What do you say? Did not get you Mr. Marks.) Professor says you shall repeat.
And Mr. Ott says that the reason of it is.	And says that the reason of it is.
That he has the toothache.	That he has the toothache.
I do not wonder at his impatience if such is the case.	I do not wonder at his impatience if such is the case.
I have been talking through the C instrument.	I have been talking with the C instrument.
With a battery line.	With a battery on the line.
I will now have Mr. Heiges remove the battery.	I will now have Mr. Heiges remove the battery.

(Mr. Heiges then removes the battery as Judge Hill directs.)

Hello, Professor.	Hello, Professor.
Do you hear me now?	Do you hear me now?
Can you hear as plainly as you did with the battery on?	Can you hear as plainly as you did with the battery on? Answer. Yes.
I have had Mr. Heiges remove the battery.	I have had Mr. Heiges remove the battery.

I have got tired of talking and will let Mr. Drawbaugh take my place awhile.	I have got tired of talking and will let Mr. Drawbaugh take my place awhile.

(Mr. Drawbaugh then takes his place at the table and speaks into the instrument.)

Professor Barker, how are you now? Ready.	Professor Barker, are you all ready? (What do you say? I did not get that quite right.) Professor says the question was asked in Mr. Drawbaugh's voice.
	Repeat.
Judge Hill is now walking the floor.	Judge Hill is now walking the floor.
I suppose he is tired.	Repeat.
I suppose he is tired.	Again.
I suppose he is tired.	I suppose he is tired.
I will now give you a little of the old talk that we had at the shop.	Repeat.
I will now give you a little of the talk we had at my shop.	Repeat again.
I will now give you a little of the old talk that we had at my shop.	(Just wait a moment.)
Professor, I have now adjusted a little different from what it was.	(Are you ready? Are you ready?) Ready now.
I have changed the adjustment a little. Does it seem any better now?	I have changed the adjustment a little. Does it seem any better? Yes, a trifle better.
Well, Harrisburg is situated on the banks of the Susquehanna River in the State of Pennsylvania.	(I can't repeat such a long sentence as that.)
Harrisburg is situated on the banks of the Susquehanna River.	Again.
Harrisburg is situated on the banks of the Susquehanna River.	I did not understand that.
I said that Harrisburg is situated on the east bank of the Susquehanna River.	I can't get it.
Professor, how do you hear now. Do you get my words plainly or not?	Hold on a minute. Are you ready now?
What instrument do you have at your end of the line?	Professor, what receiver do you have at your end of the line? (Can you tell

1817

me what receiver you have there at that end? Can you tell me what receiver you have on your end? Well. Hello. Yes, sir; we are all ready. We did not get the answer to what instrument is on your end.) Instrument I as a receiver.

Are you ready now? If you are Professor, I will count you some numbers. 1, 2, 3, 4.

Professor, I will count you some numbers,—1, 2, 4.

3, 7, 9, 12.

8, 11, 9, 12.

17, 14, 21.

17, 14, 21.

11, 16, 15.

(Now he just missed that one because you put it too far apart.)

11, 15, 21.

11, 15, 31.

42, 73, 40.

17, 23, 40.

I am now getting tired.

I am now getting tired.

I will leave someone else speak.

I will leave someone else to speak.

Professor, you please ask Judge Hill whether we have not enough of this kind of talk.

Professor, please ask Judge Hill if he has not a—please repeat the rest.

Enough of this kind of talk.

Don't get it; speak louder.

Enough of this kind of talk.

Hello. I am waiting for an answer. Yes. He say are you ready to go on. Go ahead.

You did not answer the full question.

Please repeat.

I said you did not answer the question in full—the last question.

Can't get it. Repeat.

The last question.

I think there must be a misunderstanding between us about the question. Part was not answered and part was answered. I said there must be a misunderstanding between us now.

The question that Drawbaugh asked was not all answered. Part was answered and part was not.

Are you ready now? You please ask Judge Hill if we have not enough of this kind of talk.

Please ask Judge Hill if he has not got a new kind of talk.

Enough—enough of this kind.

(Professor Barker says he does not get the last words.)

Enough of this kind of talk.

If he has not had enough of this kind of talk.

Is Ernest Marks over in that room?	(I am to ask you how you are feeling.)
I am feeling pretty warm. I am close to a hot stove.	(What is that?) I am feeling pretty warm. I think I will have to go.
I said I am near a hot stove.	I have a cold.
I said I am near a hot stove.	Repeat.
I am near a hot stove.	Repeat again.
I am near a hot stove.	Don't get it. What do you say? What do you say? I did not get what you said to me.

(Judge Hill enters the room and directs Mr. Drawbaugh to put on another instrument C.)

	Are you ready? Are you ready? Are you ready? Hello. Hello. We are ready any time you are. Very well; ready.
Professor Barker, do you hear me now?	Professor Barker, do you hear me now?
We have changed the instrument. Put on another C instrument.	We have changed the instrument. Put on another C instrument.
Judge Hill is now walking the floor of this room.	Repeat.
Judge Hill is now walking the floor of this room.	Judge Hill is now walking the floor of this room.
M. W. Jacobs is sitting on a bed in this room.	And Mr. Jacobs is sitting on a bed of this room.
Harrisburg is the capital of Pennsylvania.	Harrisburg is the capital of Pennsylvania.
It is situated on the east bank of the Susquehanna River.	Situated on the east bank of the Susquehanna River.
I see a number of overcoats lying on one of these beds.	I see a number of overcoats lying on these beds.
Also a number of hats.	Also a number of hats.
Now I think I will allow Judge Hill to take the instrument again.	Now I will give this to Judge Hill and let him speak in it.

(Judge Hill then takes his place at the table and speaks into the instrument.)

Hello. Professor Barker.	Hello. Professor Barker.

1819

How plainly do you hear me ?	How plainly do you hear me ? Answer. Very well.
Are you getting tired and ready to quit soon ?	Repeat.
Are you getting tired and ready to quit soon ?	Are you getting tired and ready to quit soon ?
How is that lamp over there ? Has there been any more explosions ?	Repeat. I was not listening.
How is that lamp over in your room? Has there been another explosion.	How is that lamp in your room ? Has there been another explosion. (What do you say ?) We are expecting another explosion.
That lamp is worse than dynamite.	That lamp is made of dynamite.
I said it was worse than dynamite.	I said it was worse than dynamite.
The British lion would turn his tail and run away from it.	Repeat.
I said the British lion would turn tail and run away from it.	The British lion is all we could hear.
The British lion would turn tail and run away from that lamp.	Would turn tail and run away before that lamp.
Do you know where Governor Cleveland is to-day ?	Do you know where Governor Cleveland is to-day.
I want to ask him to appoint me to an office.	Repeat.
I want to ask him to appoint me to an office.	Again.
I said I want to ask him to appoint me to an office.	I said I would like to ask him to appoint me to an office.
But I do not believe he would do it.	But I do not believe he would do it.
Have you any idea who his cabinet will be ?	Have you any idea who his cabinet will be ?
I do not expect a cabinet appointment myself.	I do not expect a cabinet office myself.
But I hope he will make a good one when he makes one.	But I hope he will make some good ones when he makes them.
The Atlantic Ocean is 3000 miles wide.	The Atlantic Ocean is 3000 miles wide.
The sun is about 95,000,000 of miles from the earth.	The sun is about 94,000,000 of miles from the earth.
The moon is about 240,000 miles from the earth.	The moon is about 240,000 miles from the earth.

How many students in the law class were examined in the University the other day?	How many students were examined in the law class the other day?
Now Professor Barker, will you remove the instrument I.	Repeat.
Professor Barker, will you remove the instrument I.	Repeat again.
Professor Barker, will you remove the instrument I.	Professor Barker, will remove the instrument I.
Well, you needn't remove it just yet.	Again.
I said you need not remove it just yet.	Again.
I said you need not remove it just yet.	I said you need not remove it just yet.
I want to talk a little more before you remove it.	I want to talk a little more before you remove it.
I think I was talking too loud in this instrument.	I think I was talking too loud in this instrument.
You seem to hear me more plainly now, do you not?	You seem to hear me more plainly now, do you not? I hear you very well.
It has been a very pleasant day and is a very pleasant evening.	It has been a very pleasant day and is a very pleasant evening.
The sky seems to be entirely clear of clouds.	The sky seems to be entirely clear of clouds.
The air is crisp and cool.	Repeat.
The air is crisp and cool.	The air is crisp and cold.
And a great many pretty girls were on the street this afternoon.	And a great many pretty girls were on the street this afternoon.
But I had no time to stop and admire them.	But I had no time to stop and admire them.
Perhaps that fact had something to do with your being so late.	Perhaps that might have had something to do with your being so late.
I do not blame anybody for stopping and looking along the street on such a day.	(Mr. Marks, just give me that answer again. I did not get it right.) I do not blame anybody for stopping and looking along the street.
On such a day.	Repeat.
On such a day.	Again.
On such a day.	On such a day.
Now I will speak considerably lower	Now I will speak considerably lower

than I have been speaking. How do you get that?

Now I will speak lower still. How do you get that?

Then I must have been speaking too loud in the early part of the experiment.

How is the articulation of this instrument?

You get me all right now, don't you?

I can just see the top of Mr. Marks' head through the window.

Well, I am not responsible for calling it a full moon. I suppose Mr. Marks did that.

I said I am not responsible for calling it a full moon.

When do you want to return to your house, Professor Barker.

It is now a quarter of six.

I will ask you to take off that instrument I.

And put on an instrument of the B form.

B form.

And I will put on the battery here.

Are you ready now to make the change?

(Judge Hill, speaking through the tell-tale. All right, I will speak as soon as we get the battery on. Yes. Are you ready now?) Hello, Professor Barker. Hello, Professor Barker. (At the tell-tale. Are you listening? Are you listening.) Hello, Hello, Professor Barker.

Hello, Professor Barker. Hello, Hello. Do you hear anything?

Hello, Hello. Do you hear me now?

What was the matter over there?

, than I have been speaking. How do you get that? Answer. Very well.

How I am speaking lower still. How do you get that. Better than before.

Then I have been speaking too loud in the early part of the experiment.

How is the articulation of this instrument.

You get me all right. Yes.

I can just see the top of Mr. Marks' head through the window. (The last word I missed.) Full moon.

I suppose Mr. Marks did that. Repeat the first part of the sentence.

I am not responsible for him looking like a full moon.

When do you want to return to your house, Prof. Barker? I return at six.

It is now a quarter of six.

I will ask you to take off that instrument I.

Put on an instrument of the C form.

Of the B form.

And I will put on the battery here.

Are you ready now to make the tests? Answer. Yes.

(Hold on a minute.) (Are you ready. What do you say?) Will be ready in a minute. Now ready. Go on.

(What do you say? We got our instrument on line No. 2. All ready now.

Do you hear me now?

What was the matter with the lines?

1822

Was your instrument out of adjustment?	Repeat—very faint.
Was your instrument out of adjustment?	Was your instrument out of adjustment?
Dan Drawbaugh has just returned from your room.	Dan Drawbaugh has just returned from your room.
No, I was mistaken; it was not Dan Drawbaugh, it was another gentleman.	No, I was mistaken; it was not Dan Drawbaugh, it was another gentleman.
Now there he goes.	Repeat.
Now there he goes.	Now Dan is going.
He has just come in at the door.	He has just come in at the door.
The instruments that are now on the line.	The instruments that are now on the line.
Are an instrument of the form C at this end.	Instrument of the form C on this end.
And an instrument of the form B at your end.	And an instrument of the form B at your end.
With a battery in line.	With a battery in line.
You hear perfectly well what I say, do you not?	You hear perfectly well what I say, do you not?
Suppose I give you a little geography.	(I did not have the receiver to my ear. Won't you give me an answer if you please?) It is weak but distinct.
Do you want a little geography?	Repeat.
Do you want a little geography?	Again.
Do you want a little geography—the names of some places?	Again.
Perhaps I am speaking too loud; I will speak lower.	Perhaps I am speaking too loud.
Well, how is it now?	Hello. How is it now?
Do you get me any better now than when I spoke loud?	Do you get me any better now?
Do you get me any better now than when I spoke loud?	Do you get it any better now than when I spoke loud!
What do you think about it?	What do you think about it? Answer. Yes, I do.
Well then, I will speak lower hereafter.	Repeat.
Well then, I will speak lower hereafter.	(Hold on a minute.)

1823

Well, do you hear me now ?	(Not listening. Mr. Marks is talking.)
I say Professor, do you hear me now ?	Repeat.
Hello, hello. Do you hear me now ?	Hello, hello. (Something wrong with the instrument.)
Do you hear me now ? I am speaking very low.	Do you hear me now, very low.
I will speak lower still.	I will speak lower still. Do you hear me any ? Yes.
Do you hear me any better now ?	Do you hear me any better now ?
How does that instrument compare with Exhibit I ?	How does that instrument compare with instrument I ?
Well, it is nearly six o'clock. Are you ready to stop ?	Repeat.
It is now near six o'clock. Are you about ready to stop.	It is now most six o'clock. Are you most ready to stop ? Answer. Yes.
Ready and anxious.	Repeat.
Ready and anxious.	Again.
I said are you ready and anxious to stop ?	Are you ready or not ready to stop ? I am ready.
Very well, we will say just a few words more and then stop.	Again.
Very well, we will say just a few words more and then stop.	All right, we will once more do something and then stop.
We will say a few words more.	Repeat.
Say a few words more.	Again.
We will say a few words more.	We will say a few words more and then stop.
Yes ; I was speaking too loud again. I do it involuntarily.	(Can't hear. It was too faint.)
I said I was speaking too loud again.	Repeat.
I said I was speaking too loud again.	(What do you say ?) Repeat again.
I said I was speaking too loud again.	(Hold on a moment.) All ready.
Hello.	Hello.
Do you hear me now more plainly ?	Do you hear me now more plainly ?
The pole had stuck against the armature.	Repeat.
The pole of this machine had stuck against the armature.	Again.

I said that the pole of this machine had stuck against the armature.	The pole of this instrument had stuck against the armature.
Well, Professor, is it time to go to supper now?	Professor, is it time to go to supper now?
What do you think about it?	Yes, I think it is.
All right. Good bye.	Good bye.

(At this point, it being shortly after six o'clock, the tests were closed.)

MR. DICKERSON: Are your experiments through to-day?

MR. HILL: Yes, sir.

(Mr. Dickerson then examines the instruments and asks Mr. Drawbaugh several questions as to their construction. Mr. Drawbaugh replies that the one-legged one, or one with the single stem or rod, has bronze and carbon powder; and the other, or two-legged one, or one with two stems or rods, has a carbon powder without any admixture.

Mr. Hill says that the instruments C tested here to-day are C I, which has heretofore been referred to by Professor Barker in his testimony, and another instrument which Professor Barker had not had, but which he will now please take and mark.

Professor Barker marks the instrument C 3.

Mr. Hill also states thas there is present the instrument which Professor Barker has heretofore referred to in his testimony at C 2. Mr. Hill further states that when he took the instrument C out of the bureau drawer in the room he did not know which C he was using, as marked by Professor Barker, or he would have used C 2 also, instead of the unmarked instrument. Mr. Hill also further states that all the instruments that have been tested here to-day, together with this instrument C 2, are now in the hands of the examiner, Mr. Ott.

Complainants' counsel and experts have taken apart the two tumbler instruments of the form known as F, and examined them in this room since they were tested this afternoon, and Mr. Dickerson states that they will examine the other hereafter.

At this point the meeting closed.

1425

IN THE CIRCUIT COURT OF THE UNITED STATES.

FOR THE SOUTHERN DISTRICT OF NEW YORK.

THE AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, ET AL.	In Equity.

IN THE CIRCUIT COURT OF THE UNITED STATES.

FOR THE DISTRICT OF NEW JERSEY.

THE AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, ET AL.	In Equity.

IN THE CIRCUIT COURT OF THE UNITED STATES.

FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

THE AMERICAN BELL TELEPHONE COMPANY, ET AL. vs. THE OVERLAND TELEPHONE COMPANY, THE OVERLAND TELEPHONE COMPANY OF NEW JERSEY, THE PENN OVERLAND COMPANY, ET AL.	In Equity.

A meeting of parties interested was held on Friday, Feb'y 6, after 3 o'clock P. M., in rooms 28 and 29, Washington

Hotel, Philadelphia, Pa., to witness the testing of certain Drawbaugh telephones by Professor Barker of the University of Pennsylvania, he being stationed at the end of the line connecting the two rooms which terminated in room No. 28.

The following is what transpired in room No. 28:

Complainants' counsel requests the defendants' counsel to take off the electro magnet of the instrument B form and show it.

Respondents' counsel declines to do it on the ground that he does not want the instruments interfered with until after the tests, at which time they can be examined by the complainants' counsel.

Complainants' counsel requests defendants' counsel to open instrument of the I form and show the interior of that before beginning the test.

Respondents' counsel replies that he will not allow any of the instruments to be interfered with prior to the test, but that after the test they can be examined by the complainants' counsel and experts if they wish to inspect them.

Professor Barker states that the instrument he is about listening at is B sub 2, and that it is the one he referred to in his testimony by that designation.

(The stenographer in room 28, in obedience to instructions, has reported only the words uttered by Professor Barker as being heard by him through the instrument tested at the time, together with the words transmitted back to room 29 by means of the "tell-tale," which were the words heard by the expert as coming from room 29, as well as answers to some of the questions, omitting all other remarks made by or between parties in the room.)

After a lapse of about five minutes spent in adjusting the instrument, and after Mr. Marks, at that time in communication with room 29 by means of the "tell-tale," had said to Prof. Barker, "You tell me what sounds you get over it," the following occurred:

1827

Words uttered by Prof. Barker as being heard by him through receiver of instrument tested.	Words spoken into tell-tale by the person stationed at that instrument.
Professor, do you hear me now? Is it adjusted right?	Professor, do you hear me now? Is it adjusted right? (Ans.) It is a little loose and not very loud. No better. Not as good as before. A little better.
Professor, how is it now, please?	Professor, how is it now, please? (Ans.) It is better all the time.
Well, how is it now?	Well, how is it now? (Ans.) No better.
One, two, three, four, five, six.	One, two, three, four, five, six. (Ans.) Just a little tighter. Too loose; it rattles. It is better; a little more. It is becoming better all the time.
Now I have changed it again. Is it better now?	Now I have changed it again. It is better now? (Ans.) It is very good now.
We are now in room 29, Washington Hotel.	We are now in room 29, Washington Hotel.
I think now I will let Judge Hill take the instrument.	I think now I will let Judge Hill take the instrument. (Ans.) All right. Ready.
Hello. I hardly know what to say.	Hello. I don't know what to say. I hardly know what to say.
There are a number of insulated wires against the wall.	There are a number of insulated wires against the wall.
There are three beds in this room.	There are three beds in this room. (Ans.) Repeat.
There are two short-hand writers in this room.	There are two short-hand writers in this room.
Mr. Dickerson has just sat down.	Mr. Dickerson has just sat down.
Mr. Jacobs is walking on the floor of this room.	Mr. Jacobs is walking on the floor of this room.
And Mr. Dennis Marks is standing near the door.	And Mr. Ernest Marks is standing near the door. (Ans.) Repeat that.
Mr. Coates is sitting on the lounge.	Mr. Coates is sitting on the lounge. Repeat. Not quite so loud.
There is a table before me which I am resting upon.	There is a table before me which I am resting upon.
There is a telephone cord laying on this table.	There is a telephone cord laying on this table.

Telephone cord.

It is a very pleasant day.

Washington is one hundred and forty miles from Philadelphia.

The Atlantic Ocean is three thousand miles wide.

Boston is the capital of Massachusetts.

Now I think I will allow Mr. Hill to take the transmitter.

Professor Barker, do you hear me now?

Do you distinguish the difference between my voice and that of Mr. Drawbaugh?

How is the articulation of this instrument now?

How plainly can you hear what I say?

When did you leave the University to-day.

Did you deliver a lecture before you left?

How many students had you present at your lecture?

What was the subject of the lecture?

Now, Professor, do you hear me?

Your lecture was on polarization, was it?

I should like to have been present and heard it.

Was it on the polarization of light?

Can you tell me who discovered the polarization of light and its cause?

This suit will be tried before Judge McKennan and Judge Butler.

Mr. Drawbaugh is now sitting near the bed in this room.

Telephone cord. Yes.

It is a very pleasant day.

Washington is one hundred and forty miles from Philadelphia.

The Atlantic Ocean is three thousand miles wide.

Boston is the capital of Massachusetts.

Now I think I will allow Mr. Hill to take the transmitter. (Ans.) Ready.

Professor Barker, do you hear me now? (Ans.) Yes, I hear him very well. Talk slow.

Do you distinguish the difference between my voice and that of Mr. Drawbaugh? (Ans.) Yes, perfectly.

How is the articulation of this instrument now? (Ans.) Very good.

How plainly can you hear what I say? (Ans.) Perfectly.

When did you leave the University to-day? (Ans.) About a quarter of two.

Did you deliver a lecture before you left? (Ans.) Yes.

How many students had you present at your lecture? (Ans.) Between eighty and ninety.

What was the subject of the lecture? (Ans.) Polarization.

Now, Professor, do you hear me?

Your lecture was on polarization, was it?

I should like to have been present and heard it.

Was it on the polarization of light?

Can you tell me who discovered the polarization of light and its cause?

This suit will be tried before Judge McKennan and Judge Butler.

Mr. Drawbaugh is now sitting near the bed in this room.

1629

Did you illustrate your lecture by any experiment on the polarization of light?

Chestnut Street is one of the finest streets in Philadelphia.

Does the instrument still hold its adjustment well?

Mr. Storrow is in your room, is he not?

And there is a stenographer present in the room on the part of the Bell Telephone Company, is there not?

It is said that General Gordon has either been captured or killed.

And that the position of the British army in Egypt is very precarious.

Professor Barker, suppose I read you something from a newspaper?

Are you ready now?

I read an article from the Philadelphia Press of this morning, Feb'y 6th.

Atlanta, Georgia, February five.

Honorable Thomas A. Hendricks and party.

Reached Atlanta this morning at four o'clock.

In a special car.

At half past eight.

They were escorted to the Kimball House.

Where breakfast was served.

The company assembled at breakfast.

The company they met at breakfast.

Did you illustrate your lecture by any experiment on the polarization of light?

Chestnut Street is one of the finest streets in Philadelphia.

Does this instrument still hold its adjustment well?
(Time 3:42 P. M.)

Mr. Storrow is in your room, is he not?

And there is a stenographer present in the room on the part of the Bell Telephone Company, is there not?
(3:43 P. M.)

It is said that General Gordon has either been captured or killed.

And that the position of the British army in Egypt is very precarious.
(3:44 P. M.)

Professor Barker, suppose I read you something from a newspaper? (Ans.) All right. Go ahead. Read slowly.
(3:45 P. M.)

Are you ready now? (Ans.) Yes.

I read an article from the Philadelphia Press of this morning, Feb'y 6th.

Atlanta, Georgia, February five.

Honorable Thomas A. Hendricks and party.

Reached Atlanta this morning at four o'clock.
(3:47 P. M.)

In a special car.

At half past eight.

They were escorted to the Kimball House. (Ans.) Repeat. Again.

Where breakfast was served.

The company assembled at breakfast. (Ans.) Repeat.

The company they met at breakfast.
(3:49 P. M.)

1830

Consisted of about thirty prominent citizens.

A large crowd was congregated about the hotel.

The Mayor introduced Mr. Hendricks.

Who addressed the people from the balcony.

After the speaking.

The ladies were driven around the city.

And the gentlemen proceeded to the Hall of the House of Representatives.

Where a reception was held.

And several hundred persons.

Were presented to the Vice-President elect.

The party left for Birmingham.

At ten o'clock.

And will proceed from there.

To the New Orleans Exposition.

Much enthusiasm.

Was manifested over Mr. Hendricks.

That is the end of the article.

What receiver have you now on the line at your end?

You say you have receiver B 2. Is that correct?

All right. I will now remove this instrument, F 2.

No. I have changed my mind. I will not remove it.

But I will ask you to remove your receiver.

Consisted of about thirty prominent citizens.

A large crowd was congregated about the hotel.

The Mayor introduced Mr. Hendricks.

Who addressed the people from the balcony.
(3:50 P. M.)

After the speaking.

The ladies were driven around the city.

And the gentlemen proceeded to the Hall of the House of Representatives

Where a reception was held.

And several hundred persons.

Were presented to the Vice-President elect.

The party left for Birmingham.

At ten o'clock.

And will proceed from there.

To the New Orleans Exposition.
(3:52 P. M.)

Much enthusiasm.

Was manifested over Mr. Hendricks.

That is the end of the article.

What receiver have you now on the line at your end? (Ans.) B 2. B 2. There is no A. B–B 2. The second letter of the alphabet and the second number of the numerals.

You say you have receiver B 2. Is that correct? (Ans.) It is.

All right, I will now remove this instrument, F 2.

No. I have changed my mind. I will not remove it.
(3:55 P. M.)

But I will ask you to remove your receiver.

1831

And to substitute one of the receivers of the form known as I.

When you have done that I will resume.

Now, Professor Barker, do you hear me?

Do you hear me any more plainly than you did with the receiver, B 2?

Please answer back whether you do or do not.

Suppose now I read you an article from the newspaper.

Are you ready? Please answer back.

I will read another article from this morning's Philadelphia Press.

It is entitled Hearty Endorsement of General Logan.

And is copied from the New York Independent.

It is as follows:

We sincerely desire the re-election.

To the United States Senate.

Of Genera! John A. Logan, of Illinois.

He has been a very useful and true man.

Has done good service to his country.

As a soldier.

And is greatly respected in Congress.

He has the entire confidence.

And to substitute one of the receivers of the form known as I. (Ans.) I was not listening. Please repeat.

When you have done that I will resume.

(3:56 P. M.)

Now, Professor Barker, do you hear me? (Ans.) Yes; very well.

Do you hear me any more plainly than you did with the receiver B 2?

Please answer back whether you do or do not. (Ans.) He says he hears you just as distinctly and a little louder.

Suppose now I read you an article from the newspaper.

Are you ready? Please answer back. (Ans.) Yes; but speak a little louder.

(3:55 P. M.)

Tell him to repeat. We were talking in here. The Professor was not listening.

I will read another article from this morning's Philadelphia Press.

It is entitled Hearty Endorsement of General Logan?

(4:00 P. M.)

And is copied from the New York Independent.

It is as follows:

We sincerely desire the re-election.

To the United States Senate.

Of General John A. Logan, of Illinois.

(4:01 P. M.)

He has been a very useful and true man.

Has done good service to his country.

As a soldier.

And is greatly respected in Congress.

He has the entire confidence.

	(4:02 P. M.)
Of the Republican party.	Of the Republican party.
And of the people generally.	And of the people generally.
Both in and out of the State.	Both in and out of the State.
Whom he now so ably represents.	Whom he now so ably represents.
Who he now so ably represents.	Who he now so ably represents.
No. Not who. He.	No. Not who. He.
He now so able represents.	He now so ably represents.
And who doubtless will have.	And who doubtless will have.
As he deserves to have.	As he deserves to have.
The solid vote.	The solid vote.
Of all the Republicans.	Of all the Republicans.
	(4:04 P. M.)
Of the Legislature of Illinois.	Of the Legislature of Illinois.
To secure his return to the Senate.	To secure his return to the Senate.
That is the end of the article.	That is the end of the article.
And I cordially endorse what it says.	And I cordially endorse what it says.
My friend, Mr. Drawbaugh, would probably take the opposite side.	My friend, Mr. Drawbaugh, would probably take the opposite side.
	(4:05 P. M.)
Now I will remove instrument F 2.	Now I will remove instrument F 2.
And substitute another form of F instrument.	And substitute another form of F instrument.
Which is a carbon box supported by two rods or wires.	Which is a carbon box supported by two rods or wires.
	(4:06 P. M.)
The one I have been using.	The one I have been using.
Had the carbon box supported by a single rod.	Had the carbon box supported by a single rod. (Ans.) Yes; we are ready if you are.
Professor, do you hear me?	Professor, do you hear me?
How is the adjustment?	How is the adjustment? (Ans.) Don't talk so loud.
How is that?	How is that? (Ans.) Better. The question was how is that? The answer, better.
I asked how is the adjustment?	I asked how is the adjustment. (Ans.) Not good.

1893

Is is too loud or too weak.

Is it too loud or too weak? (Ans.) Too loud.
(4:11 P. M.)

I commenced to use it without adjusting it.

I commenced to use it without adjusting it.

I took it out of the box.

I took it out of the box.

And I hitched it to the line.

And I hitched it to the line.

Just as it was.

Just as it was.

But I will now adjust it a little.

But I will now adjust it a little.

If you think it will work better.

If you think it will work better.

What do you think about it?

What do you think about it? (Ans.) I think the articulation might be improved.

Well, how is this now?

Well, how is this now? (Ans.) Very weak.
(4:13 P. M.)

I have changed it a little. How is it now.

I have changed it a little. How is it now? (Ans.) Good as to loudness, but the articulation is not yet perfect.

Perhaps I have spoken a little too loud into it. How is it now?

Perhaps I have spoken a little too loud into it. How is it now? (Ans.) Better.
(4:14 P. M.)

I spoke too loud, I suppose.

I spoke too loud, I suppose.

Do you think you could hear a newspaper article now?

Do you think you could hear a newspaper article now? (Ans.) Yes.

I will read you something again from this morning's Press.

I will read you something again from this morning's Press.
(4:15 P. M.)

Washington, February five.

Washington, February five.

There were quite a number of absentees.

There were quite a number of absentees. (Ans.) Repeat.

On the Democratic side.

On the Democratic side.
(4:16 P. M.)

Of both the House and Senate chambers.

Of both the House and Senate chambers.

This morning.

This morning.

And the invariable answer was.

And the invariable answer was.

When a Senator or Representative could not be found.

When a Senator or Representative could not be found. (Ans.) Repeat. Again. He wants you to repeat again.

1834

Gone to see Cleveland.

Several of these gentlemen.

How is it now.

Now how is it?

Now I will resume the newspaper article where I left off. Do you get that?

Are you ready?

Well, how is it now? Do you get it any plainer?

How is it now?

Well, is it good now still?

Shall I resume the newspaper article now?

Several of the gentlemen.

Who have been contemplating visits to the President elect.

Upon the public notice that he would be at home.

To all persons desiring to talk with him.

Regarding Governmental business.

Were surprised to learn.

That special invitations.

Had been extended.

To a majority of the Senators.

And quite a number of the more prominent Representatives.

Gone to see Cleveland.

Several of these gentlemen. Ans. Repeat. Repeat a little louder. The adjustment is bad. Ans. Very weak.

How is it now? Ans. Better, if you will talk lower.

Now how is it? Ans. Good, but speak a little lower.

Now I will resume the newspaper article where I left off. Do you get that? Ans. Yes.

Are you ready? Ans. No. Adjust a little closer.
(4:20 P. M.)

Well, how is it now? Do you get it any plainer. Ans. No; very weak.

How is it now! Ans. Very good.

Well, is it good now still. Answer. Yes.

Shall I resume the newspaper article now? Answer. Yes; but talk a little lower.

Several of the gentlemen.

Who have been contemplating visits to the President elect.

Upon the public notice that he would be at home.
(4:22 P. M.)

To all persons desiring to talk with him.

Regarding Governmental business.

Were surprised to learn.

That special invitations.

Had been extended.
(4:23 P. M.)

To a majority of the Senators.

And quite a number of the more prominent Representatives.

1885

This fact, however.

Is intended in no way.

To preclude others from calling upon Cleveland.

Those who have had invitations.

Understood that their visits.

Were primarily to make the acquaintance of the President elect.

And to talk with him.

And discuss with him.

Matters of Legislative and Executive policy.

Rather than to give advice.

As to the selection of a Cabinet.

The more prominent visitors, however.

Will not hesitate to give Mr. Cleveland.

Their views regarding Cabinet appointments.

Their views.

Regarding Cabinet appointments.

And the friend of Mr. McDonald.

Mr. Barbour.

Mr. Many.

M-a-n-e-y.

M-o-n-e-y.

Mr. Money.

Mr. Hopkins.

S-t-e-a-k-b-o-n.

S-t-a-e-k.

O, not a.

Mr. Stockton and others.

This fact, however.

Is intended in no way.

To preclude others from calling upon Cleveland.

Those who have had invitations.
(4:24 P. M.)

Understood that their visits.

Were primarily to make the acquaintance of the President elect.

And to talk with him.

And discuss with him.

Matters of Legislative and Executive policy.
(4:25 P. M.)

Rather than to give advice.

As to the selection of a Cabinet.

The more prominent visitors, however.

Will not hesitate to give Mr. Cleveland.

Their views regarding Cabinet appointments.
(4:26 P. M.)

Their views.

Regarding Cabinet appointments. Ans. Repeat.

And the friends of Mr. McDonald.

Mr. Barbour. Ans. Repeat.

Mr. Many.

M-a-n-e-y.
(4:27 P. M.)

M-o-n-e-y.

Mr. Money.

Mr. Hopkins. Ans. Repeat. Again. Repeat again.

S-t-e-a-k-b-o-n.

S-t-a-e-k.

O, not a.

Mr. Stockton and others. Ans.

Repeat.
(4:29 P. M.)

Will tell Mr. Cleveland.

Will tell Mr. Cleveland.

Why they think.

Why they think.

He should choose those gentlemen.

He should choose those gentlemen.

For posts on the Executive Board.

For posts on the Executive Board.
(4:30 P. M.)

That is the end of the article, Professor.

That is the end of the article, Professor.

How is the adjustment now?

How is the adjustment now? Ans. Very good.

I have not adjusted it since I commenced to read the article.

I have not adjusted it since I commenced to read the article.

The second time.

A second time.

I have held it in my hand all the time.

I have held it in my hand all the time.
(4:31 P. M.)

What receiver have you on your end of the line?

What receiver have you on your end of the line? Ans. I one.

Now will you remove I one and substitute an instrument of the B form?

Now will you remove I one and substitute an instrument of the B form? Ans. Yes. Ready.
(4:33 P. M.)

What receiver have you now on?

What receiver have you now on? Ans. B 2.

How is the articulation with this instrument?

How is the articulation with this instrument? Answer. The articulation is good. But it is weak
(4:34 P. M.)

We will have it adjusted a little then.

We will have it adjusted a little then. Ans. Yes; if you please.

How is it now?

How is it now? Ans. It is much better.

It is well enough adjusted now?

Is it well enough adjusted now?
(4:35 P. M.)

Please answer back.

Please answer back. Ans. It is in fair adjustment now.

Repeat please.

Repeat please. The answer was that the instrument is in fair adjustment now.

What time do you generally go to dinner?

What time do you generally go to dinner?

1839

It is now twenty-five minutes of five.

I will talk to you a little upon the B receiver.

In order to test that instrument.

How do you get the tones now?

This is a very pleasant day.

Washington is one hundred and twenty miles from Harrisburg.

I will count regularly a series of numbers.

One, five, ten, twenty-four.

Thirty-nine, thirty-three, thirty-seven, forty.

Forty-five, fifty-seven, sixty-eight.

Seventy four, eighty-one, ninety-three.

One hundred and thirteen, one hundren and twenty-five, one hundred and fifty.

One hundred and thirty-five.

One hundred and fifty.

Sixty.

Two hundred and ten.

Three hundred and thirty.

Twenty.

Four hundred and one.

Nine hundred and one.

Eighteen hundred and seventy-six.

Eighteen hundred and eighty-five.

How does the adjustment of this instrument hold out?

I have not adjusted it since I began

It is now twenty-five minutes of five. (4:37 P. M.)

I will talk to you a little upon the B receiver. Ans. Repeat please.

In order to test that instrument.

How do you get the tones now? Ans. Very well.

This is a very pleasant day.

Washington is one hundred and twenty miles from Harrisburg, (4:38 P. M.)

I will count regularly a series of numbers.

One, five, ten, twenty-four.

Thirty-nine, thirty-three, thirty-seven, forty. (4:39 P. M.)

Forty-five, fifty-seven, sixty-eight.

Seventy-four, eighty-one, ninety-three.

One hundred and thirteen, one hundred and twenty-five and one hundred and fifty. (4:40 P. M.)

One hundred and thirty-five.

One hundred and fifty.

Sixty.

Two hundred and ten.

Three hundred and thirty. (4:41 P. M.)

Twenty.

Four hundred and one.

Nine hundred and one.

Eighteen hundred and seventy-six.

Eighteen hundred and eight-five.

How does the adjustment of this instrument hold out? Ans. Very good. (4:42 P. M.)

I have not adjusted it since I began

to read the newspaper article the second time.

I will now remove this instrument and put on an instrument of the C form.

Are you ready?

Hello. Do you hear me now?

Well, how plainly do you hear me.

Are you getting tired of listening, Professor Barker?

Now, are you all ready to begin?

Mr. Drawbaugh and Mr. Jacobs are now standing up.

Mr. Dickerson is examining the instrument F.

And has already taken it apart.

Mr. Pope and another gentleman are examining it with him.

It is now ten minutes of five.

And I will put this test through as rapidly as possible.

General Grant is said to be quite ill.

He is afflicted with a trouble of the throat.

Caused by an excessive use of tobacco.

to read the newspaper article the second time.

I will now remove this instrument and put on an instrument of the C from.
(4:43 P. M.)

Are you ready? Does the Judge wish the Professor to put on instrument I on this end? (The answer was, yes, sir.) This is hard work on this end, Judge. The Professor is getting tired. We are ready now. All right. It will be ready in a minute. All ready. Ready.

Hello. Do you hear me now. Ans. Yes, sir.

Well, how plainly do you hear me. Ans. Distinctly; but not very loud.

Are you getting tired of listening, Professor Barker? Ans. Yes, for my side. The Professor says he is not tired of listening now, since he has a receiver of smoother edge. It is all right. Go ahead.
(4:47 P. M.)

Now, are you all ready to begin? Ans. Yes.

Mr. Drawbaugh and Mr. Jacobs are now standing up.
(4:48 P. M.)

Dr. Dickerson is examining the instrument F.

And has already taken it apart.

Mr. Pope and another gentleman are examining it with him.

It is now ten minutes of five.
(4:49 P. M.)

And I will put this test through as rapidly as possible.

General Grant is said to be quite ill.

He is afflicted with a trouble of the throat.

Caused by an excessive use of tobacco.
(4:50 P. M.)

1839

And Mr. Drawbaugh.	And Mr. Drawbaugh.
When he just heard me say this.	When he just heard me say this.
Threw his tobacco away.	Threw his tobacco away.
Mr. Ott, the examiner.	Mr. Ott, the examiner.
Is looking.	Is looking.
Quite impatient.	Quite impatient. Answer. Repeat. The Professor wishes you to repeat.
And says that the reason of it is.	And says that the reason of it is. (4:52 P. M.)
That he had the toothache.	That he had the toothache.
I don't wonder at his expression if such is the case.	I don't wonder at his expression if such is the case.
I have been talking through C instrument.	I have been talking through the C. instrument.
With a battery on the line.	With a battery on the line.
I will now have Mr. Heygus remove the battery.	I will now have Mr. Heygus remove the battery. (4:53 P. M.)
Hello. Professor.	Hello. Professor. (4:54 P. M.)
Do you hear me now ?	Do you hear me now ?
Can you hear as plainly as you did with the battery on ?	Can you hear as plainly as you did with the battery on ? Answer. Yes.
I had Mr. Heygus remove the battery.	I had Mr. Heygus remove the battery.
I have got tired of talking and will let Mr. Drawbaugh take my place a while.	I have got tired of talking and will let Mr. Drawbaugh take my place a while. (4:55 P. M.)
Professor Barker, are you all ready?	Profes or Barker, are you all ready? Ans. The Professor says this question is in Mr. Drawbaugh's voice. (4:56 P. M.) Re eat, please.
Judge Hill is now walking the floor.	Judge Hill is now walking the floor. Answer. Repeat. Again.
I suppose he is tired.	I suppose he is tired. (4:57 P. M.) Repeat.
I will now give you a little.	I will now give you a little. Ans. Repeat. Repeat the rest. Repeat again.

(4:58 P. M.)

All right. Wait a moment. One moment while the Professor makes a note.

(4:59 P. M.)

We are ready now.

(5:00 P. M.)

I have change the adjustment a little. Does it seem any better now?

I have changed the adjustment a little. Does it seem any better now? Ans. Yes; a trifle better. Repeat.

(5:01 P. M.)

Again. I don't understand it. I cannot get it. (At this point a servant brought lamps into the room.) Hold on a moment.

(5:03 P. M.)

Are you ready now?

(5:05 P. M.)

What do you say? All right. Go ahead.

Professor, what receiver have you at the end of the line.

Professor, what receiver have you at the end of the line? Answer. An I receiver. Hold on. We had an explosion here. (At this point Judge Hill stationed himself at the tell-tale.) All right now. Well, boom along.

Hello.

Hello. Ans. All right. Go ahead.

Professor, I will give you some numbers.

Professor, I will give you some numbers.

One, two, four.

One, two, four.

Eight, eleven, nine, twelve.

Eight, eleven, nine, twelve.

Seventeen.

Seventeen.

(5:09 P. M.)

Eighteen.

Eighteen.

Twenty-one.

Twenty one.

Eleven.

Eleven.

Fifteen.

Fifteen.

Eleven, fifteen, thirty-one

Eleven, fifteen, thirty-one.

Seventeen, twenty-three, forty.

Seventeen, twenty-three, forty.

(5:10 P. M.)

I am now getting tired.

I am now getting tired.

I will leave some one else speak.

I will leave some one else to speak.

Professor, will you please ask Judge Hill if he hasn't a.

Professor, will you please ask Judge Hill if he hasn't a. Answer. Please

1841

repeat the rest. Don't get it. Speak louder. Hello. Heygus, the lamp has just broken again. Wait a minute. Well, now are you ready to go on? Go ahead. Please repeat.

(5:12 P. M.)

Cannot get it. Repeat. No.

(5:13 P. M.)

Hold on a moment. Did not get you all. Somebody came in at the moment. Please repeat.

(5:14 P. M.)

Well, tell them to ask the question again.

Tell him to ask Judge Hill if he hasn't a new kind of talk.

Tell him to ask Judge Hill if he hasn't a new kind of talk.

(5:15 P. M.)

Professor Barker says he does not get the last word.

If he has not had enough of this kind of talk.

If he has not had enough of this kind of talk.

(5:16 P. M.)

Ans. Hello. Heygus. Ask Dan. how he is feeling.

I am feeling pretty warm and I will have to go.

I am feeling pretty warm and I will have to go.

(5:17 P. M.)

Repeat.

I have a cold.

I have a cold. Repeat. Again. Repeat again.

(5:18 P. M.)

Don't get it. Put on another instrument C. Heygus. (At this point Mr. Marks takes his place at the tell-tale.) We are ready here, I believe. All right now.

(5:21 P. M.)

Professor Barker, do you hear me now?

Professor Barker, do you hear me now?

We have changed the instrument and put on another C instrument.

We have changed the instrument and put on another C instrument. Answer. Repeat.

Judge Hill is now walking the floor of this room.

Judge Hill is now walking the floor of this room.

(5:22 P. M.)

And Mr. Jacobs is sitting on the bed in this room.

And Mr. Jacobs is sitting on the bed in this room.

1842

Harrisburg is the capital of Pennsylvania.

It is situated on the east bank of the Susquehanna River.

I see a number of overcoats lying on these beds.

Also a number of hats.

Now I will give this to Judge Hill and let him speak in it.

Hello. Professor Barker.

How plainly do you hear me?

Are you getting tired and ready to quit there.

How is that lamp in your room.

Has there been another explosion?

That lamp is made of dynamite.

I said it was worse than dynamite.

The British lion.

Would turn tail and run away before that lamp.

Do you know where Governor Cleveland is to-day.

I said I would like to ask him to appoint me to an office.

But I don't believe he would do it.

Have you any idea who his cabinet will be?

I don't expect a cabinet appointment myself.

Harrisburg is the capital of Pennsylvania.

It is situated on the east bank of the Susquehanna River.
(5:23 P. M.)

I see a number of overcoats lying on these beds.

Also a number of hats.

Now I will give this to Judge Hill and let him speak in it.

Hello. Professor Barker.
(5:24 P. M.)

How plainly do you hear me. Ans. Very well. Repeat.

Are you getting tired and ready to quit there? Repeat. I was not listening.
(5:25 P. M.)

How is that lamp in your room.

Has there been another explosion. Ans. We are expecting one. We are expecting another explosion.

That lamp is made of dynamite.
(5:26 P. M.)

I said it was worse than dynamite. Repeat.

The British lion, is all we got here.

Would turn tail and run away before that lamp.
(5:27 P. M.)

Do you know where Governor Cleveland is to-day? Repeat. Again.

I said I would like to ask him to appoint me to an office.

But I don't believe he would do it.

Have you any idea who his cabinet will be?

I don't expect a cabinet appointment myself.
(5:29 P. M.)

But I hope he will make some good ones when he makes them.

The Atlantic Ocean is three thousand miles wide.

The sun is about ninety-four millions of miles from the earth.

And the moon is about two hundred and forty thousand miles from the earth.

How many students in the law class were examined at the university the other day?

Professor Barker, will you remove the instrument I?

I said you need not remove it just yet.

I want to talk a little more before you remove it.

I think I was talking too loud into this transmitter.

You seem to hear me more plainly now, do you not?

It has been a pleasant day and is a very pleasant evening.

The sky seems to be entirely clear of clouds.

The air is crisp and cold.

And a great many pretty girls are on the street this afternoon.

But I had no time to stop and admire them.

Perhaps that might have had something to do with your being so late.

I don't blame anybody for stopping to look along the street at pretty girls.

But I hope he will make some good ones when he makes them.

The Atlantic Ocean is three thousand miles wide.

The sun is about ninety-four millions of miles from the earth.

(5:30 P. M.)

And the moon is about two hundred and forty thousand miles from the earth.

How many students in the law class were examined at the university the other day?

(5:31 P. M.)

Repeat. Hold on a moment. There is so much noise now. Now repeat. Repeat again.

Professor Barker, will you remove the instrument I? Again. Again.

I said you need not remove it just yet.

I want to talk a little more before you remove it.

I think I was talking too loud into this transmitter.

You seem to hear me more plainly now, do you not? (Ans.) Yes; I hear you very well.

It has been a pleasant day and it is a very pleasant evening.

The sky seems to be entirely clear of clouds. Repeat.

The air is crisp and cold.

And a great many pretty girls are on the street this afternoon.

But I had no time to stop and admire them.

Perhaps that might have had something to do with your being so late.

What is it? Give that answer again. I have to get it from a reporter here. I have to get it from the reporter. I don't blame anybody for

On.

On such a day.

Now I speak considerably lower than I have been speaking.

How did you get that?

Now I am speaking lower still. How do you get that?

Then I have been speaking too loud in the early part of the experiments.

How is the articulation on this instrument?

You get me all right now, don't you?

I can just see the top of Mr. Marks' head through the window.

I suppose Mr. Marks did that. Repeat the first part of the sentence.

I said I am not responsible for its looking like a full moon.

When do you want to return to your house, Professor Barker?

It is now quarter of six.

And I will ask you to take out that instrument I.

And put on an instrument of the C form.

Of the B form.

And I will put on the battery here.

Are you ready now to make the test?

stopping to look along the street at pretty girls. Repeat.

Again.

On such a day.

Now I speak considerably lower than I have been speaking.

How did you get that? Ans. Very well.

Now I am speaking lower still. How do you get that? Ans. Better than before.

Then I have been speaking too loud in the early part of the experiments.

How is the articulation on this instrument?

You get me all right now, don't you? Ans. Yes.

I can just see the top of Mr. Marks' head through the window. Ans. (By Mr. Marks.) That is moonshine; moonshine; full moon. Yes.

I suppose Mr. Marks did that. Repeat the first part of the sentence.

I said I was not responsible for its looking its full moon.

(5:40 P. M.)

When do you want to return to your house, Professor Barker? Ans. I return at six.

It is now quarter of six.

And I will ask you to take out that instrument I.

And put on an instrument of the C form.

(5:41 P. M.)

Of the B form.

And I will put on the battery here.

Are you ready now to make the test? Ans. Yes. All right. Go ahead.

(5:42 P. M.)

All right. You tell me when it is

on. Hello. We are ready. Yes. One moment. Ready now.
(5:43 P. M.)

What do you say? Didn't get anything here. Hold on a minute. Go on. All right. Hold on. There is no battery on this line. One moment. We are ready. Go on.
(5:45 P. M.)

(At this point Mr. Drawbaugh came into the room, and picking up the instrument said: "Perhaps in putting the pole on he may have damaged the poles. This is a little close. Now, try it.") Mr. Marks through the tell-tale. Now go on. We are ready here. Go on.

Hello.

Hello.

Do you hear me now?

Do you hear me now?
(5:48 P. M.)

What was the matter with the line?

What was the matter with the line? Repeat. Very faint.

Was your instrument out of adjustment?

Was your instrument out of adjustment?

Mr. Drawbaugh has returned into this room.

Mr. Drawbaugh has just returned in this room.

No, I was mistaken; it was not Dan Drawbaugh, it is another gentleman.

No, I was mistaken; it was not Dan Drawbaugh, it is another gentleman.
(5:49 P. M.)
Repeat.

Now Dan is coming.

Now Dan is coming.

He has just come in the door.

He has just come in the door.

The instruments that are now on the line

The instruments that are now on the line.

Are instruments of the form of C at this end.

Are instruments of the form of C on this end.

And an instrument of the form of B on your end.

And the instrument of the form of B on your end.

With a battery and line.

With battery and line.

You hear perfectly well what I say, do you not?

You hear perfectly well what I say, do you not? Ans. Yes, it is weak but it is distinct.
(5:50 P. M.)

Do you want the answer? It is weak but distinct. Repeat.
(5:51 P. M.)
Again. Again

Perhaps I am speaking too loud.

Perhaps I am speaking too loud.

How is this?

How is this? Answer. Better.

Well, how is it now?

Well, how is it now?

Do you get me any better now?

Do you get me any better now?

Do you get me any better now than when I spoke loud!

Do you get me any better now than when I spoke loud?

What do you think about it?

What do you think about it? Answer. Yes, I do. Repeat.
(5:53 P. M.)
Hold on a minute. Go on now. There was a noise in the next room. Repeat.

Hello. Hello.

Hello. Hello.

Do you hear me now?

Do you hear me now? Ans. Very low.

Shall I speak lower still?

Shall I speak lower still?

Do you hear me now?

Do you hear me now? Ans. Yes.

Is that any better now?

Is that any better now?

How does that instrument compare with instrument I?

How does that instrument compare with instrument I? Repeat.

It is now nearly six o'clock. Are you about ready to stop.

It is now nearly six o'clock. Are you about ready to stop? Answer. Yes
(5:55 P. M.)

Repeat. Again.

I said, are you ready or not? Ready to stop.

I said are you ready or not? Ready to stop? Ans. I am ready. Again.

All right, we will do (something) once more and then stop.

All right, we will once more do something and then stop. Repeat, if you please. Again.

We will say a few words more and then stop.

We will say a few words more and then stop.
(5:57 P. M.)

I cannot hear. It is too faint. Repeat. Again. Repeat again if you please. I cannot hear you at all. (Mr. Marks, to Professor Barker. Will you not see if the poles have come together again? Professor Barker to Mr. Marks. The magnet is a little

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Hello.

Do you hear me now more plainly?

The pole of this instrument has stuck against the armature.

Well, Professor, is it time to go to supper now?

loose.) All right. Go on and try again.

Hello.

Do you hear me now more plainly? (5:59 P. M.)

Repeat. Again.

The pole of this instrument has stuck against the armature. (6:00 P. M.)

Well, Professor is it time to go to supper now? Answer. Yes, I think it is. What do you think about it? Good bye.